REPORT

OF THE

Controller and Auditor-General

ON

The Use of Computers in the Public Sector 1980

Presented to the House of Representatives Pursuant to Section 33 of the Public Finance Act 1977

BY AUTHORITY:
P. D. HASSELBERG, GOVERNMENT PRINTER, WELLINGTON, NEW ZEALAND—1980

Price $3.25c

THE USE OF COMPUTERS IN THE PUBLIC SECTOR

In my second report to Parliament last year I informed the House that I intended to report to Parliament on the current use of computers within the public sector and the extent to which management is efficiently using and properly controlling these and related resources. This review has now been completed and is submitted to the House for consideration.

The review has been carried out and the report prepared by a multi-disciplinary team assisted by advice from private sector individuals and reporting to a special steering committee. The steering committee comprised:

Mr J. T. Chapman, Deputy Controller and Auditor-General—Chairman.
Mr J. R. Battersby, Assistant Secretary to the Treasury.
Mr D. I. Brown, Personnel Manager, Shell New Zealand Holding Co. Ltd.
Dr I. F. Jackson, Chairman of the Department of Quantitative and Computer Studies, University of Otago.
Mr N. C. Perkins, Financial Controller, Canterbury Frozen Meat Co. Ltd.
Dr M. C. Probine, Commissioner, State Services Commission.
Mr I. R. Small, Finance Director, Challenge Corporation Ltd.
Mr B. A. Wickes, Data Processing Manager, New Zealand Insurance Co. Ltd. and 1979–80 President of the New Zealand Computer Society.

The personnel of this steering committee and the private sector advisors contributed a wealth of experience and expertise and their work is gratefully acknowledged. I would like to thank their respective employers for making such key people available. I would also like to pay a tribute to the ready co-operation received from all the organisations and people approached for information. This applies particularly to the data processing and management staff in the public and private sector organisations visited. Special mention should be made of the Reserve Bank of New Zealand and Air New Zealand Ltd., who, although not audited by the Audit Office, willingly completed our questionnaire, supplying valuable background information.

The computer now plays a significant part in the lives of all New Zealanders. However, all too often the computer itself is blamed when things go wrong. Generally, a computer will do only what it is instructed or programmed to do. If it is not managed correctly it will not perform. The taxpayers and ratepayers of New Zealand have invested heavily in computers. Are they getting "value for money" from this investment?

To help answer this and other related questions I decided to set up a special study drawing on experience from both the public and private sectors. In the report which follows, the main problem areas have been isolated and recommendations have been made which are aimed at improving the present systems. I hope these recommendations will be given earnest and favourable consideration by the Government, local authorities, statutory boards, and corporations.

I would urge all readers of this report to bear in mind—

1. That the report is directed at systems presently in operation and should not be taken as a criticism of any particular individual.
2. That it should not be assumed that all computing in the public sector is worse than in the private sector.

Indeed, the private sector members of the steering committee have agreed that most of the problems identified in this report have been experienced by private sector computer installations and many of the recommendations, especially those in Part I, would be regarded as good practice in the private sector.

A. C. SHAILES,
Controller and Auditor-General.

The Audit Office,
Wellington,
New Zealand.
30 July 1980.

CONTENTS

	PAGE
Introduction	7
Reason for this Review	7
Status of Computing in New Zealand	7
Approach to the Review	8
Staffing of Project	8

PART I—OBSERVATIONS COMMON TO ALL PUBLIC SECTOR ORGANISATIONS

Management	10
Top Management Involvement	10
Effective Communication	10
Planning for Computers	11
Adequate Time to Implement Decisions	11
Proper Resource Allocation	11
A Wide View of Computer Developments	12
Recommendations	12
Personnel and Training	13
Introduction	13
The Number of Data Processing Staff	14
Vacancies	14
Turnover	14
Recruitment	15
The Quality of Data Processing Staff	15
Experience and Qualifications	16
Training	17
The Need for Professional Status in Data Processing ...	17
Recommendations	18
Social Implications of Computing	19
Recommendations	20
Development of Computer Applications	20
Recommendation	22
Acquisition of Hardware and Software	23
Concentration on Hardware Costs	23
Pioneering New Equipment and Systems Software	24
Hardware Purchase Contracts	24
Recommendation	24
Systems Performance Evaluation	25
Introduction	25
Sizing	25
Reviewing Applications Programs	26
Monitoring Hardware and Systems Software Performance ...	26
Recommendations	27
Data Communications and Networks	28
Introduction	28
Communication Protocols	28
Changes in Post Office Data Communication Services ...	28
Post Office Tariff Structures for Data Communication ...	29
Recommendations	29

PAGE

Co-operation between Public Sector Organisations, Data Interchange, and Security 30
Cost Savings through Co-operation 30
Data Integrity and Privacy 31
Recommendations 32
Private Sector Services 32
Recommendations 34

PART II—ISSUES SPECIFIC TO EACH CLASS OF PUBLIC SECTOR ORGANISATION

Computing in Central Government 35
Background 35
The Control of Central Government Computing 36
Recommendations 39
The Roles of CSD 39
Recommendations 41
Large Computer Centres 42
Recommendations 43
Long-term Planning and Procurement 44
Recommendations 45
Project Development and Control 45
Recommendations 46
CSD Operations and Service Role 47
Recommendations 48
Cost Responsibility 48
Recommendations 49
Computing in the Health Services 51
Introduction 51
Control of the Health Services Project 53
Difficulties in Further Implementation 55
The Embargo on Hospital Board Computing 57
The Future Direction of Computing in the Health Services ... 58
Recommendations 60
Control Over Large Computer Projects 62
Recommendations 62
Computing in Educational Institutions 64
Introduction 64
A Comprehensive Policy for Educational Computing ... 64
Recommendations 65
Common Software Development 66
Recommendation 67
Co-ordinated Hardware Purchases 67
Recommendations 67
Supplementing University Computing Resources 68
Recommendations 68
Computing in Statutory Boards and Corporations ... 69
Computing in Local Government 70
Introduction 70
The Role of Top Management in Computers 70
Recommendations 71
Duplication of Applications Development 71
Recommendation 72

Applications Development Standards 72
Recommendation 72
Staffing 73
Recommendation 73
Procurement 73
Recommendation 74
Preoccupation with Accounting Applications 74
Recommendations 75

APPENDICES

1. Terms of Reference 76
2. List of Organisations Visited 77
3. Submissions from Major Computer Suppliers, Software Houses, New Zealand Computing Services Association, and New Zealand Computer Society 79
4. Brief Guidelines for the Management of Computers ... 84
5. Evaluation of Installations Formally Reviewed 89
6. Statistics from the Survey of Computing in the Public Sector ... 94
7. List of Observations, Issues, and Recommendations ... 104
8. Glossary 119

INTRODUCTION

Reason for this Review

The Audit Office periodically conducts across-the-board reviews of management controls to ascertain whether resources are being used efficiently and effectively. The approach is to review management procedures with a view to improvement rather than criticism of the past. This is the second major review of this type and covers the use of computers in the whole public sector—central government, government corporations, statutory boards, and the complete range of local authorities and educational institutions.

The review was initiated from within the Audit Office and reflects a growing concern over a number of years at the expenditure on computing and apparent problems which have arisen with developing, implementing, and operating computer systems.

Computing in the New Zealand public sector has only a 20-year history, with dramatic changes in technology over this period. Widespread use of computers in the public sector has occurred only in the last 10 years. During this period there has been rapid expansion in the use of computers and consequent increases in expenditure and the number of staff employed.

This growth and the high rate of change in the technology itself has introduced a new group of specialists and created difficulties for managers who do not have data processing backgrounds. There is a complex array of software and hardware to choose from when developing computer systems, and total resource commitments, including personnel, are substantial. Decision makers are concerned at the difficulties they face when confronted with proposals for new installations and enhancements or replacements of existing systems and facilities.

There have been management problems in projects for the development and implementation of new computer systems. Continuing computer operations and the level of service provided are also causing managers concern. Shortages of skilled staff have hindered the development of systems to meet requirements within the time desired by management.

These factors led the Audit Office to select the management of computers as a subject for review.

Status of Computing in New Zealand

New Zealand is well advanced in the use of computers compared with most other industrialised countries, although accurate comparative information is difficult to obtain. The U.S.A. stands out as making the greatest use of computers, with most other industrialised countries at a similar technical though less intensive level of use.

The public sector employs 2800 data processing staff, which is approximately a quarter of New Zealand computing staff. This is comparable with the proportion of staff in the public sector in relation to the whole New Zealand work force. The experience and qualifications of public sector data processing staff are similar to and in some cases slightly above their private sector counterparts. There are 341 public sector organisations using 373 computers and 70 bureaux (with 314 separate arrangements). The estimated value of computers within the organisations is $111 million and the annual expenditure on computing in 1978–79, the latest date for which information was obtainable, was $58.5 million.

Inset 2

Approach to the Review

The terms of reference (see Appendix 1) required a comprehensive survey and detailed review which it was decided would be approached in two phases. First, a questionnaire was sent to each of the Audit Office clients known to use a computer and also to all organisations in particular local government categories—territorial authorities (cities, boroughs, counties, etc.), harbour boards, hospital boards, electric power boards, licensing trusts, and catchment boards. This was necessary as little information was available on the extent and cost of computer use, especially in non-accounting areas. Overall, 521 organisations completed the questionnaire and the most significant results are summarised in Appendix 6.

Second, visits were made to a selection of computer users and staff were interviewed. This covered all large computer installations and users, a majority of medium-sized users, and a selection of small users. Altogether, over 100 public sector organisations were visited. Eight private sector organisations were also visited to provide a comparison and to confirm whether there was any major difference between the management of computers in the two sectors. Normally, discussions were held with the chief executive, member of top management responsible for data processing, data processing manager, technical staff for systems development, operations, and systems software performance, and a selection of users. It was also necessary to consult a number of organisations concerned with general policy areas such as data communications. The organisations visited are listed in Appendix 2.

To assist in the review of computer installations and users, a set of guidelines for the management of computers was developed along with questionnaires and an evaluation table for formally assessing the installations. The management guidelines and evaluation table are set out in Appendices 4 and 5.

In preparing a report on a highly technical area of activity such as computing it is not possible to entirely avoid technical terminology. Though such terms have been kept to a minimum a glossary to describe those used has been provided as Appendix 8.

Staffing of Project

Although the review team basically comprised Audit Office staff, it was necessary to obtain advice and assistance from people experienced in data processing.

Review team members:

D. R. Hutton (Project Manager).
G. Vaughan-Jones (Deputy Project Manager).
C. N. Amadio.
M. J. Ball (State Services Commission).
K. M. Tan.
L. D. Webber.
S. P. Williams.

Private sector consultants:

D. W. Botherway, Idaps Computer Science (N.Z.) Ltd.
K. I. Mitchell, Computer Consultant.
J. W. Yates, Data Processing Manager, Canterbury Frozen Meat Co. Ltd.

Messrs. L. Lorden and M. K. Evans of the Department of Statistics assisted in the computer analysis of the results of the survey of 521 organisations. Mr T. J. Abbott of the Tourist and Publicity Department helped with editing.

The Audit Office gratefully acknowledges the importance of the work of the private sector consultants and by many other data processing staff who spent time with the review team. The co-operation of the State Services Commission, Department of Statistics, and Tourist and Publicity Department in making staff available is also acknowledged as being of special assistance.

PART I
OBSERVATIONS COMMON TO ALL PUBLIC SECTOR ORGANISATIONS

This section deals with the broad issues applicable to the whole range of public sector organisations. Some of the management problems discussed are not unique to the public sector and could equally be applied to private sector computer installations. The aim is to discuss the problems observed in the context of what is regarded as good management. The discussion is not totally exhaustive and should not be regarded as including all possible difficulties and solutions. However, the commentary and recommendations endeavour to provide positive guidance for management on how to avoid common pitfalls and to remedy some of the frequently observed problems.

MANAGEMENT

Successful use of computers, expecially in ensuring that systems provide satisfaction to users, depends on many factors.

Top Management Involvement

Observation:

1. *Senior management are generally not giving the commitment to computing needed to ensure it is a success.*

Top management commitment to computer projects is an essential ingredient. Far too many managers abdicate their responsibility and are involved only superficially in computer projects. This may mean that they do not appreciate the importance of key decisions which commit the organisation to a particular approach to computing for a number of years.

The majority of organisations in the public sector provide services rather than goods. The continued supply of this service is often dependent upon the quality and reliability of information. Many information systems are computerised. It is therefore necessary for managers to understand the capabilities and limitations of computers if they are to use them effectively.

Computing is a technology which requires special understanding before a manager has the necessary background to fully appreciate the potential gains from computer systems. Managers without computer experience tend to believe they are unable to adapt. This is, of course, a fallacy for it is never too late to learn.

Effective Communication

Observation:

2. *Customary lines of communication within the organisation have often not been established. The EDP section is often treated as a special case and may not have ready access to the top management team.*

Data processing sections have frequently grown up within operating divisions, especially finance. This occurred because computers were a natural growth from accounting machines. The data processing manager in such a situation does not have a direct line of reporting to top

management. A consequence is that formal reporting on EDP to elected representatives is often by managers with little experience in the area.

The data processing manager may be skilled and experienced in computing but often is not trained as a manager and usually has little general management experience.

Planning for Computers

Observation:

3. *Planning for data processing functions, if prepared, is normally not an integral part of an overall corporate plan.*

The need for computer systems flows from the requirements for information as part of the overall functions of the organisation. This means that proper strategic planning for computer functions is only possible if the organisation has some comprehensive plan for its future information requirements. Planning for computers needs to fit into this structure.

Planning for computers is essential. All new developments of systems as well as equipment or software purchases have lead times. Large systems may have a lead time of 2 years but even for the smallest it will be a number of months. This does not mean that plans should be inflexible as the technology and pricing change rapidly. Planning will help avoid crisis situations and rushed systems development with the risk of missed deadlines and systems which are inefficient or unsuitable.

Adequate Time to Implement Decisions

Observation:

4. *Decisions have been made by both top management and elected representatives without adequate consideration of the likely effect on data processing.*

As noted, computer systems require time for development if they are to meet the user's needs. Decisions which require new or amended computer systems must be made taking into account the necessary lead time. There are examples in both central and local government of systems where development was required in an unrealistic time span.

The effects of too short a time for design and implementation of a computer system may be:

1. System incomplete at date the policy is implemented. This may mean management information is not available for some months.
2. Inadequate system which requires major redesign or rewriting.
3. Complete re-scheduling of priorities for other systems being developed with consequent delay. These other systems may have greater tangible benefits than the priority system. This economic loss from delay may not have been considered.

These situations suggest that elected representatives need an appreciation of the time requirements of computer systems design. This highlights the need for ready access and consultation between data processing management, top management, and elected representatives.

Proper Resource Allocation

Observation:

5. *Decisions to purchase or lease computers have been made without full awareness of total costs.*

Decisions to purchase or lease a computer must take all costs into account, not just the cost of the hardware. Typically, hardware accounts for about only one-third of costs; the remainder comprises mainly staff to operate the machine and develop systems, and the cost of any software purchased. Purchase of a computer involves a commitment to these recurring costs. These factors are becoming more important as the costs of hardware are reducing in real terms compared with processing capability. This is accentuated by vendor practice to separately charge for hardware and software.

When a decision is made to acquire computer equipment it is often assumed that skilled, trained staff will be readily available. This assumption has proved incorrect in a number of installations visited. For some large sites staff were required with scarce skills in areas such as telecommunications and systems programming. Recruiting these staff has taken a number of years. Similar problems apply to local authorities in provincial centres where there are few people with the requisite analyst and programmer skills.

A Wide View of Computer Developments

Observation:

6. Existing systems have been computerised without recognition of the potential of alternatives or the wider ranging implications for related systems.

The development of data processing systems should provide opportunities to make innovative changes which make proper use of the powers of computers and suit the requirements of all levels of management.

All too often, existing manual systems are converted to the computer without any alteration to the basic procedures. This means that the limits and faults of the manual system may be perpetuated. Often the needs of only the section originally proposing the change have been considered.

Organisations also tend to regard their needs as unique, requiring systems designed specifically to suit themselves. Management should be aware that this may be a costly, time-consuming option with greater risks of technical difficulties. While there are some individual requirements, the majority are common and it is important that a wide range of alternative options be considered, e.g. software packages, turn-key systems perhaps on a stand-alone minicomputer, or purchasing a major software package which could well require the consequent purchase of a particular brand of machine.

The essential point is that management should look at a whole range of options when major changes are contemplated. These options must include revision of the manual system. Even for smaller systems, there is a need to look at management implications throughout the whole organisation.

Recommendations:

1. **Managers should be encouraged to understand the use and management of computers as this is becoming an essential element of their responsibilities. The data processing element of existing management training courses should be increased.**
2. **Data processing managers should be given additional exposure to general management problems so that they can identify with the corporate image and goals.**

3. **The EDP function should be separated from operating sections and report to the member of top management responsible for management services functions for the whole organisation.**
4. **Management should develop both strategic (3–5 year) and short-term (1–2 year) plans for computer developments with clear identification of priorities.**
5. **Before decisions are made, elected representatives should ensure that they are adequately advised of the likely impact on data processing.**
6. **Decisions to introduce computing or to develop major projects should be based on careful study of the full costs of the system, including the software and recurring costs and the availability of suitable skilled staff.**
7. **Management should ensure that the development of systems includes the consideration of a wide range of options and is not constrained by existing systems or organisational tradition.**

PERSONNEL AND TRAINING

Introduction

The public sector employs approximately a quarter of the data processing staff in New Zealand. This compares with the proportion public sector employment represents in the whole New Zealand work force. These data processing employees are distributed throughout the public sector in the following proportions:

	Percent
Central government	57
Local authorities	27
Statutory boards and corporations ...	16
	100

An analysis of staff responsibilities shows the following:

	Percent
Data processing management	7
Applications development	29
Operations	30
Data preparation	34
	100

The survey of public sector computer organisations showed that 9 percent of staff positions were vacant. The largest proportion of these vacancies was for applications development staff. Trainees employed mainly as computer operators, data preparation staff, and application programmers accounted for 11 percent of the total staff positions.

Few staff currently employed were recruited directly from universities and technical institutes. Most data processing staff came from within the organisation (34 percent), other employment (34 percent), or directly

from secondary school (21 percent). Direct recruitment from overseas was significant only for larger computer installations in central government, statutory boards, and corporations.

Formal qualifications are rare in data processing—70 percent of staff had no tertiary qualifications. Fourteen percent have qualifications majoring in data processing subjects, and a further 12 percent have other university qualifications.

The commonly held image of data processing personnel is that they are introverted and find communication difficult. This view was not supported by experience in interviewing the wide range of data processing staff in over 100 installations visited.

The Number of Data Processing Staff

Staffing is the single most important factor constraining the development and successful implementation of data processing. This is not a problem unique to New Zealand.

Observation:

7. *There have been persistent problems of vacant positions, high staff turnover, and the inability to readily recruit trained staff. Though the problems have been recognised for some time, the situation has tended to be accepted rather than action being taken to alleviate the difficulty.*

Vacancies

At September 1979, 9 percent of data processing positions (that is 275 positions) were vacant in the public sector. The position was most critical in the main central government computer centres where 20 percent vacancies existed. As noted earlier, applications development staff account for 29 percent of total data processing staff and 60 percent of vacancies are in this area. The most significant shortages are in the analyst and systems programmers positions. These shortages could be alleviated to some degree by greater use of software packages. However, this is not an easy option for many of the specialised tasks of central government. Even if development was stopped completely, application staff would still be necessary for the maintenance work.

The effect of these vacancies has been to slow down the development of computer applications and prevent some projects from starting. Existing staff have been under pressure and lower priority has been accorded to tasks such as user liaison, documentation, project control, and formal reporting. The existence of vacancies in systems programmer positions is a major reason why little attention has been given to systems performance evaluation. There are also significant shortages of staff with proven expertise in specialist areas such as data base, data communications, and project management.

Turnover

Staff turnover is costly to any organisation. It can affect the continuity of projects and cause delays due to the time required to replace staff and the subsequent period of training and orientation.

With a few exceptions, average turnover rates for data processing staff throughout the public sector for each of the last 2 years have been more than double the average for the public sector and have ranged up to 80 percent. Turnover has been highest for computer operators, data

preparation operators, and programmers. Turnover is lowest for management and supervisory positions.

Where the majority of staff are relatively young and seek a wide range of data processing experience, staff retention will always be difficult. To achieve greater stability in staff numbers it is essential that a sound and planned professional development programme be established for the full range of data processing staff, as follows:

(i) A continuing staff training programme to cater for all levels of experience.
(ii) Procedures to monitor the type and quality of work and to ensure staff receive a variety of challenging tasks.
(iii) Clearly defined alternative career paths.

A well organised work environment can be an important factor in motivating staff and aiding staff retention.

Many data processing staff change jobs to gain further experience. However, the public sector and particularly central government, because of the variety of its activities and tasks, has the potential to provide challenging work. This potential has not been fully realised as part of a definite policy to aid staff retention.

Part of the present problems in the staffing area is due to data processing management not fully appreciating the importance of these staff motivation factors.

Recruitment

The main sources of recruitment are from within the organisation, other employment, and directly from secondary school. This pattern is departed from in local government, where most staff (54 percent) come from within the organisation, and statutory boards and corporations, which rely on recruitment from the private sector (48 percent).

Recruitment from within the organisation is generally extremely successful and turnover is lower. As existing staff already have a sense of organisational loyalty they are less likely to leave, and familiarity with the organisation aids applications development work. This form of recruitment requires a high commitment to training.

While university and technical institute students provided only 8 percent of recruits, this is a significant source for applications development staff (20 percent).

Overseas recruitment is significant and accounts for 12 percent of staff for the large central government centres. Over the past 3 years 48 staff were directly recruited from overseas, but two-thirds have since left the public sector or left New Zealand. This makes it an expensive form of recruitment for central government although there is benefit to New Zealand as a whole from those recruits who remain in the country. Submissions from the computer industry emphasised that the skills available from within New Zealand have not always been fully appreciated and that overseas recruitment should be restricted to very select skills. If existing staff are denied opportunities to develop skills, this could be one reason for losing them to challenges elsewhere.

The Quality of Data Processing Staff

Observation:

8. *The shortages and high turnover of data processing staff have consequences of lower levels of experience and faster promotion than desirable. This needs to be compensated for by more emphasis on education and training.*

Experience and Qualifications

As data processing is a new industry, average years in EDP are relatively low. The following figures for the public sector are probably indicative of the industry as a whole.

	Average Years in EDP
Data processing management	10.1
Applications development staff—	
Planner/analysts	6.0
Analyst/programmers	5.6
Programmers	3.7
Systems programmers	4.7
Operations staff—	
Computer operations supervisors	5.4
Computer operators	2.8
Data control	4.8
Data preparation supervisors	7.2
Data preparation operators	4.8

Tertiary qualifications are most important for data processing management and applications development staff. Of the public sector development staff, 30 percent have tertiary education in EDP subjects and a further 27 percent in subjects other than EDP.

The desirability of tertiary qualifications in EDP is recognised within the industry although there are few students completing such courses. In 1979, only 149 students completed certificate, diploma, or degree courses in data processing at universities or technical institutes. A much larger number of students received some data processing exposure as part of qualification in other subjects. Technical institutes also run a number of 4–6 week block courses in data processing.

There has been criticism that the courses in educational institutions, especially universities, are not sufficiently orientated towards commercial data processing. As 75 percent of public sector computer applications are of a commercial type it is clear that public sector employers need staff with commercial data processing training.

Up to the present most university degrees in data processing have been in computer science, stressing subjects such as hardware design, operating systems, and compilers. These may not be entirely relevant in a country where no commercial computers are designed or manufactured. There are few courses in the areas where critical staff shortages exist, such as data base, data communications, systems performance evaluation, analysis and systems design, and computer management.

It is desirable for tertiary institutions to provide more commercially orientated courses and it must be acknowledged that the universities are developing such courses. There is a trend towards more degrees which combine data processing with another subject, for example business studies. The University Grants Committee is studying course structures in relation to employer requirements for a number of subjects including computing.

It is important that the short-term requirement for programmers is not allowed to dominate course structures. Intensive block courses appear to be the most effective method of initial training for programmers.

Training

In a fast-changing area like data processing, training is essential. Most of the current training is haphazard and organised to meet specific short-term demands for skills needed for particular applications or changes in hardware or systems software. Most of this training is conducted within computer installations, supplemented by hardware vendor courses.

In the installations visited, few examples were found of a fully co-ordinated professional development programme linking training records for individuals, current needs, and the future career development of all staff. In many organisations, particularly with small-sized or medium-sized computers, there is a great reluctance to train because of the expense and the high staff turnover. Too many managers do not recognise that training is an investment for the future, and must be properly planned both for individual development and to fulfil the organisation's requirements. A Computer Society submission stressed that private sector installations are not fulfilling their obligations to train staff but it seems that the same problem exists within many organisations in the public sector.

A critical shortcoming of current training procedures is the failure to teach potential data processing managers management skills. This must become an integral part of training.

When the university educates lawyers, engineers, accountants, and architects, the respective professional societies expect at least 2 years of practical experience before individuals qualify for admission. A practical experience requirement should also be regarded as necessary by employers of data processing graduates.

As well as training data processing staff, users and top management need to be trained so that they can employ computers as an effective tool. Top management who have recognised the need for an appreciation of data processing have encountered difficulty obtaining suitable training. One Government department recognised this problem last year and held a very successful 1-day seminar introducing data processing to top management. However, not all organisations in the public sector are large enough to justify such seminars, so suitable alternatives are necessary.

There is an urgent need to co-ordinate training and education in the data processing field.

The Need for Professional Status in Data Processing

Observation:

9. *As a new and rapidly changing technology, data processing has yet to develop into a recognised profession with formal standards for entry and a minimum level of competence. This leaves employers without readily ascertainable measures of knowledge and skill for staff they recruit.*

There is no formal co-ordination of the data processing degrees or courses of tertiary educational institutions and no recognised body with the status to formally recommend co-ordinated approaches. This means that there is considerable variation in the composition of degrees and no common base of subject matter.

Unless courses are co-ordinated and a minimum level of competence is recognised, employers must carefully examine the composition of an applicant's degree or experience, to ensure suitability for employment; even then there is a risk of the person not being suitable.

With the increasing sensitivity of information being placed on computer files and the greater public awareness of such issues as privacy, there is a need for a strict code of ethics for data processing. Without a recognised professional body it is difficult to develop and enforce such a code.

There is a growing call for recognition of professional status especially for data processing managers, applications development staff, and computer operators. The need for any professional body normally gains recognition over time, but there are advantages in having such a body now. New Zealand already has a Computer Society which has fairly rigorous requirements for entry to full membership and is active in many areas of data processing including study of educational needs. The society's status could be improved if employers required membership at least for certain positions.

Recommendations:

8. **The management of individual organisations should seek to alleviate problems of data processing staff shortages and high turnover by:**
   (a) Increasing recruitment from within the organisation.
   (b) Providing a well organised work environment, reasonably challenging work, professional development, and well defined alternative career paths.
9. **Recruitment from overseas should be restricted to personnel with select skills and should not be carried out at the expense of staff within New Zealand. Overseas training of New Zealand data processing staff should be considered.**
10. **The review of university courses under the auspices of the University Grants Committee should encourage the development of university data processing courses which are more closely aligned to the long-term needs of New Zealand, for example, analysis and design, data base, data communications.**
11. **An industry training board for data processing should be established under the Vocational Training Council. This board should encourage better training, and co-ordinate courses in data processing for both the public and private sectors. The need for a comprehensive policy for educational computing and computer studies syllabuses is covered in the section on computing in educational institutions. The data processing industry board would need to liaise closely with the Department of Education in the development of computer studies syllabuses.**
12. **Data processing managers of large computer centres should ensure that co-ordinated professional development programmes are devised for their staff. Such programmes should include provision for data processing managers, project managers, and graduate recruits, as these groups have not received much training in the past.**
13. **The New Zealand Computer Society should be encouraged to continue its efforts towards status as a full professional body setting entry and registration standards and monitoring tertiary education courses.**

SOCIAL IMPLICATIONS OF COMPUTING

Observation:

10. There is little evidence, to date, that computing has affected the overall level of employment in the public sector. The most significant changes due to computing have been in the type of skills required.

Staff savings are often used to justify new data processing projects. At present, cost/benefit studies include staff reductions as a benefit but do not consider the social implications. Only in few cases have staff levels actually dropped, though many organisations using computer systems have handled increased volumes of work without staff increases.

In central government, of the 15 departments where significant use is made of data processing, only one has had a substantial decrease in total staff levels since the introduction of computer systems. Even in this one example it is difficult to prove that the reduction was solely due to the computer, though some of the reduction must be accredited to it. In local government, very few reductions in staff levels have occurred as existing staff have been trained to operate and program computers.

In many cases staff have been retrained to use the computer or transferred to other positions within the organisation. Where organisations operate under staff ceiling limits, management have also used any reductions in staff positions through computers to expand activities in other areas. As computer systems are generally in administrative support areas, more staff have been made available for direct service to the public. Even where existing staff have not been suitable for the new tasks, natural turnover has been used to phase in the changes.

There have already been considerable changes in the types of job skills required for computers. These have mainly been met by retraining which will need to continue. However, with some computer applications employees have been displaced because the new tasks required a higher level of skill. Even clerical work requires a higher degree of accuracy if data is to be processed by a computerised system. Some other applications require staff with fewer skills than their previous positions, for example ledger machinists retrained as data entry operators. However, in many organisations, especially in local government, ledger machinists become the operators for minicomputers requiring very similar skills.

The growth of communications will mean that data entry will return to the work-place rather than becoming more centralised. This will help to keep jobs in smaller centres rather than create demand in major centres for highly trained staff.

Possible displacement of staff has become an emotive issue yet little detailed research has been undertaken. Emphasis is placed on the microprocessor chip which has affected relative cost structures making many computer applications economic which were previously too costly. There is little evidence in the public sector of any overall significant reductions in staff solely attributable to computers. To what extent the new technology will further affect the public sector is difficult to project. Much will depend on the type of computer applications developed and management attitudes. For example, optimisation applications or management information systems may require small increases in staff, while the introduction of word processing may result in fewer staff. Research to determine the effect of computing on employment and the skills required is necessary to develop policies for the future direction of

public sector computing. Overseas experience suggests that, to be worthwhile, such research is likely to be substantial and costly.

Recommendations:

14. Throughout the public sector and especially in central government the effects of computer systems should be evaluated from a social as well as a technical and economic viewpoint. This will require cost/benefit studies to include the social implications of a project.

15. The Government should undertake research to determine the probable future effect of new technology on the levels of employment and the job skills of staff.

16. Retraining of staff affected by data processing systems should continue to have a high priority to minimise the effects of job displacement.

DEVELOPMENT OF COMPUTER APPLICATIONS

Observation:

11. Many public sector organisations do not follow a logical and comprehensive set of procedures when developing computer applications. Under such circumstances the possibility of not achieving the original system aims and objectives is increased.

Over a period of time procedures have become accepted as points to be covered in the development of any computer application. The broad guidelines are listed in part A of Appendix 4.

The particular areas in which problems were encountered during visits to public sector computer installations are commented on below:

1. *Planning Projects*

There were examples of projects which were inadequately planned and this had led to cost and time overruns. The need to properly plan the development of an EDP system is as important as the planning of any other major organisational task. Planning sets the stage for the success of a project and its importance cannot be overestimated. The purpose of project planning is to foresee steps which must be taken to accomplish stated objectives and then to logically arrange those steps into manageable segments to ensure easy project completion.

2. *Project Development Responsibility*

Examples were found where it was not clear who had the final responsibility for a particular project. The project manager is the key to the successful completion of any project and such a person must be given the necessary authority prior to development work commencing. It is essential that the final responsibility for a project be under the direct control of a strong and capable manager. This person should be responsible for the creation and meeting of deadlines, adhering to predetermined budgets, and ensuring the technical quality of the system.

3. *Project Control*

Project control is the process by which the project activities and costs are monitored against established schedules and budgets. Many

situations were found in which there was inadequate control of costs and time spent on projects. Situations were found where particular project development costs were simply included in normal data processing departmental overheads making it impossible to separate out particular project costs. Where there is little or no project control, sub-standard systems development often results. In the development of medium to large systems, it is generally accepted that to minimise the risk of cost overruns and inadequate systems, detailed project control procedures should be followed. Project control procedures are set out in a variety of sources ranging from text books to detailed methodology packages. It should be noted that methodology packages are not effective substitutes for sound management and senior management involvement.

4. *Problem Definition*

In the development of any system there is normally some overriding limitation or "problem" which the organisation is trying to overcome. In the development of an accounting application the problem may be lack of financial information in the proper form for decision making. This problem needs to be documented and agreed on so that the overall objective of the system is not lost.

Instances were found where prior to the development work there had not been a clear and concise description of the problem. Problem definition had sometimes been ignored when there had been insufficient time or if an existing system was being computerised.

5. *Requirement Specifications and User Involvement*

In a number of installations, requirement specifications had either not been prepared or they were inadequate. The overriding concern in the development of any EDP system should be the provision of a facility which satisfies the user. Once a user requirement specification is produced this still needs to be studied in detail to determine what user demands are economically feasible and what requests are beyond available resources. There have been occasions when development staff have attempted to meet all demands and in so doing have created major design problems. Clearly, to avoid confusion and to ensure a project is guided properly, a detailed requirement specification must be prepared for all projects. This specification must result from an adequate investigation to identify all users and ensure a thorough coverage of user needs.

6. *Cost/Benefit Studies*

For many new projects either no cost/benefit study had been prepared or the one prepared was inadequate. For any project all costs and benefits should be detailed so that management can make an initial decision to proceed on the basis that significant returns can be obtained from a new system. At each critical stage in development the original cost/benefit study should be reassessed and, if the relative benefits cannot then be proven, further development should not proceed until the whole project has been referred back to senior management.

7. *Availability of Alternative Development Methods*

There are numerous examples in which organisations in all areas of the public sector have chosen to develop their own systems irrespective of whether a suitable system could be obtained from a similar organisation

or was available in package form. Staff resources are often scarce and as package-type systems are now readily available this method is often a viable alternative.

8. *Underestimation of Size and Complexity*

On numerous occasions data processing development staff and project planners underestimated the size and complexity of projects. This was caused in the main by inadequate preliminary investigation, inadequate design and sizing, and attempts to build into systems every conceivable demand of users. Underestimation can lead to time and cost overruns.

9. *Standards for Developing Applications*

The design, programming, documentation, and other procedural standards necessary for developing a computer system were often not formalised and in some cases no standards existed. In the long term, an organisation must benefit by following uniform work standards for analysis, design, and programming of new applications. Not only is maintenance work simplified but staff changes are not so disruptive if standards exist.

10. *Testing of Applications*

Testing is extremely important in that it provides the method to determine whether the application and system as a whole are functioning properly. There are two stages in testing—program and full system testing by data processing staff, and user testing of actual transactions. Testing by data processing staff was generally well done. However, in some cases users submitted no, or inadequate, test data and in very few cases did they formally approve and accept the system. This testing and approval is an important part of user acceptance and satisfaction with the system.

11. *Post-implementation Review*

Post-implementation reviews were not common. These reviews must be conducted for all applications to ensure the original objectives have been achieved, adherence to documentation standards, compliance with normal procedures for testing and conversion, consideration of user criticism, and a final review of actual costs and benefits. In addition there is a need for older systems to be periodically reviewed to ensure their continuing effectiveness.

Recommendation:

17. When developing a computer system it is important for management to ensure:

- **(a) A project manager is made responsible for the planning and control of the project.**
- **(b) The problem definition is documented and agreed, to provide an objective for the project.**
- **(c) Potential users define their requirements in ordinary language. Management should review the completeness and feasibility of these requirements.**
- **(d) The project has a detailed cost/benefit study. This should be reviewed at critical stages in development.**

(e) Consideration has been given to the alternative of obtaining similar or packaged systems unless management is satisfied that it is desirable to develop a system using resources available within the organisation.

(f) The necessary investigations are conducted to determine the size and complexity of projects. In some situations this may entail obtaining independent technical advice.

(g) Design, programming, documentation, and other procedural standards are formally recorded for all installations.

(h) Users are fully involved in testing, that is, supplying test data and formally approving the results.

ACQUISITION OF HARDWARE AND SOFTWARE

The procurement problems of large and small installations are essentially the same; the differences are of scale. The major problem in this area is that managers are often not aware of the factors they should consider or the options available to them.

Concentration on Hardware Costs

Observation:

12. *Computer acquisition evaluation normally concentrates on hardware rather than the total cost. Insufficient consideration is given to the range of available alternatives to the purchase of hardware and development of own-design software. Inadequate effort is devoted to defining current and future resource requirements for hardware, software, and staff.*

As previously noted, hardware cost normally accounts for only one-third of the total cost of an installation. Software, staff, maintenance, and other operating costs make up the other two-thirds. It is essential to cost all major options when making a decision on data processing equipment and software. Hardware options, apart from the use of a bureau or the purchase of a new computer, include tuning existing equipment, the use of minicomputers dedicated to particular tasks, second-hand equipment, and plug-compatible equipment. The software options, apart from own design, include the purchase of commercially produced application packages, existing applications from other organisations, and a system specially developed by a software house. For example, if a major software application package is available at a reasonable price, it may be better to purchase the package and the particular computer for which it was designed. This course was successfully followed by a power board and two harbour boards.

Current and future requirements need to be properly assessed, otherwise there is a substantial risk that hardware and staff resources will be inadequate or excessive in relation to actual requirements. Instances were noted both of an organisation purchasing computers with twice the capacity required and conversely of a local authority that underassessed its requirements for hardware by $250,000.

It is essential to consider upward compatibility when purchasing, to protect current and future investment in application software and expertise.

Future requirements need to take into account software conversion costs. Such conversions are expensive and should not be attempted unless

the benefits justify the cost, particularly in retraining staff. This includes not only the cost of courses but also the period of low productivity while staff gain experience. Software conversion may take several work years which would otherwise be available for applications development.

Pioneering New Equipment and Systems Software

Observation:

13. *Pioneering new computer equipment and systems software is difficult and often carries a high degree of risk.*

Pioneering can cause delays and additional costs and increases the risk of failure. Unique installations must bear all specific engineering, spares, and support costs. Vendor support can be meagre unless, or until, further sales are made or until vendor staff have obtained sufficient experience with the new product.

Hardware Purchase Contracts

Observation:

14. *Computer hardware purchase contracts often omit vital clauses relating to maintenance and the setting of performance criteria.*

Maintenance arrangements and performance criteria for computers should be agreed when the purchaser is negotiating the initial contract. Unless these points are settled at this stage the purchaser is in an inferior negotiating position. Some organisations have suffered great expense and frustrations because of these omissions. Small installations at remote sites may well have a limited range of vendors prepared to support equipment in their locations. In these cases it is of great importance to have a tight contract.

Setting performance criteria for computers necessitates management defining their requirements precisely. These should be written into the contract so that equipment can be returned or replaced if it does not perform to specification in the time specified. Monetary penalties can be included for large purchases. Performance criteria and deadlines are also essential parts of software contracts.

Recommendation:

18. When making acquisition decisions, management should:

(a) Establish total computer resource requirements to meet both existing and future needs.

(b) Consider the full range of processing options available including facilities within the organisation, bureau use, and sharing facilities with other organisations.

(c) Prior to upgrading or replacing an existing computer consider all other possibilities such as tuning existing hardware, running extra shifts, or using dedicated minicomputers for certain tasks.

(d) Prior to the development of own-design software, consider the full range of options including the use of standardised packages and developed software from other organisations.

(e) Consider the interdependence between hardware and software.

(f) State requirements in a non-technical manner and request vendors to comment. This helps to ensure that a wider range of possibilities is considered.

(g) Consider relevant alternatives. Ensure options have been listed, for example second-hand or plug-compatible equipment, other third party equipment, mainframe expansion versus dedicated minicomputer, use of bureau.

(h) Ensure costings are complete. All maintenance, other running costs, additional staff, and conversion costs should be included.

(i) Ensure tender clearly states requirements. The technical specification should include formal evaluation criteria.

(j) Evaluate responses using a consistent basis and select the most suitable, cost-effective tender.

(k) Ensure equipment performance criteria, maintenance agreement, and delivery dates are included in the purchase contract.

SYSTEMS PERFORMANCE EVALUATION

Introduction

Management should be aware that there are substantial potential gains in the efficiency of computers and their software through the use of technical reviews of performance known as monitoring or tuning. The potential gain is in the range of 10 percent to 20 percent for all but the very smallest computers.

Observation:

15. *Management has not ensured that computer resources are used efficiently through requiring properly conducted reviews of hardware, systems software, and major applications. Systems performance evaluation techniques are not widely employed in the public sector and, even where employed, are normally not on a continuing basis.*

It is clear from visits to installations that in few organisations is management fully aware of the potential of systems performance evaluation. However, very few installations have reached the limits beyond which gains are no longer positive. Of the 33 installations visited where such techniques were applicable, only 3 had specific staff whose duties included the tuning of hardware and application programs on a continuing basis. At a few other installations tuning techniques had been utilised on an irregular basis. There are three aspects which need to be considered—sizing computer applications, reviewing applications programs, and monitoring hardware and systems software performance.

Sizing

Sizing computer applications is the process of estimating the hardware required to operate the particular system being considered. This applies at the time a computer is being purchased, replaced or upgraded and when any major application is being developed. The main questions are: "What size computer and peripheral equipment is needed to run this application (or all applications)?"; or alternatively, "Will this new

application fit on the existing computer equipment and what impact will it have on existing applications?"

This requires an initial crude estimation of the likely size of an application, continuously updated during the development phase as a check on the likely running costs and resources required. The size of an application should also be reviewed once the system is operational, as a check on the accuracy of these estimates.

There are examples in the public sector where systems development has been commenced without adequate sizing. Failure to size applications may result in:

(a) Purchase of a computer which cannot adequately handle the planned tasks. As a consequence, further hardware purchases become necessary. There are examples of this having occurred in local government including situations where independent advice was sought on the capabilities of the machine.
(b) Design of applications programs which cannot fit on the existing machine or require more running time than is available.
(c) Inadequate disc file capacity requiring further expenditure.
(d) For on-line systems, major impact on service to existing users so that response times become unacceptable.
(e) Purchasing more computer equipment than required.

Reviewing Applications Programs

Once applications are running there may be gains from reviewing the efficiency of individual programs. Few installations are using such review techniques but those that are report that gains of up to 20 percent may be achieved.

Frequently-run programs should be emphasised as these make the greatest use of computer resources. These programs should be reviewed in detail to identify the modules used most frequently. The interaction between operating system and program code may be improved to reduce the number of instructions executed.

Older systems should also be reviewed regularly, especially to ensure that gains from modern technology are applied. For example, computer output to microfiche may be used to replace printouts or, on a larger machine, several small programs may be profitably combined to reduce operator intervention.

Monitoring Hardware and Systems Software Performance

Large and medium-sized computers may be tuned to increase throughput by up to 20 percent. With small computers the options for adjusting hardware and systems software are limited and generally not worthwhile.

The reasons for tuning computers, like tuning a motor vehicle, are to increase efficiency and productivity. Tuning involves discovering the bottlenecks in the total system through monitoring the operation of individual hardware components and the interaction of the hardware with the operating system (and other systems software, e.g. data base management system and telecommunications software). By eliminating these bottlenecks the performance of the whole installation can be improved. The cost of tuning is small in relation to the potential savings.

The tools for tuning are hardware and software monitors. Software monitors are programs that measure events from within the computer and

therefore run only on machines for which they are designed. This form of monitor takes up a small amount of memory and is itself a system overhead (usually about 5 percent). These monitors operate in two ways—either sampling all occurrences of a specified operation, e.g. all disc seeks; or in "snapshots", recording a number of systems parameters at predetermined intervals. Hardware monitors are external to the system and do not affect its performance. Typically, measurements are made of CPU activity, channel controllers, input/output devices, telecommunication activity, and terminal response items. Some of the basic checks include:

- Comparison of equipment performance against manufacturer's rated specifications.
- Review of the placement of disc files to minimise head movement. This applies especially to frequently used files such as the main catalogue.
- Review of block buffer sizes to optimise input/output transfers.

Computer installations are rarely static and the hardware and mix of applications frequently alter over relatively short periods. This means that tuning needs to be a recurring process as problem areas change over time.

The major advantage from tuning is that, by allowing greater output from existing resources, the need for upgrades of equipment can be deferred. While tuning in conjunction with sizing of applications should be a continuous process, it becomes particularly important when an installation is having difficulty:

- meeting peak demands for service and balancing workloads;
- processing all work scheduled for a particular day or week;
- meeting acceptable response levels for interactive systems.

Some of the larger installations visited were using software monitors and undertaking some tuning. None has yet purchased a hardware monitor. Failure to tune machines leads to unnecessary expenditure on additional equipment or higher running costs (staff and maintenance) through longer running hours.

Recommendations:

19. Before commencing development of computer applications, estimates should be made of the likely requirement for hardware resources. For major applications these estimates should be continuously updated during the development phase.

20. Applications programs which make significant use of computer resources should have their efficiency reviewed on a continuing systematic basis.

21. For all medium to large computers, management should ensure that systems performance is monitored on a recurring basis. For large installations this will require specialised staff who will need access to suitable monitors.

DATA COMMUNICATIONS AND NETWORKS

Introduction

Data communications is an important part of many computer systems and is becoming increasingly so with the growth of on-line and distributed processing. Data communications is the term used to describe equipment which links a computer with remote terminals or other computers. This can be done using either permanently wired leased lines or the public telephone network. Currently in New Zealand some 800 separately leased mainline circuits, a large number of local circuits, and a further 600 connections for dial-up equipment are in use for data communications. The leased line service suits users with high volumes of messages or fast response needs. The dial-up service suits low use or occasional users, and enables communication with any other dial-up user having compatible equipment and exchange data. The Post Office is sole supplier of data communication circuits in New Zealand. It also provides the modems for dial-up connections and for some leased circuits.

The Communications Advisory Council has the function of advising the Government on the formulation and co-ordination of longer term national telecommunications policies. The council is in the process of studying data communication networks including likely future development. Future development will be critical to the whole of the data processing industry in New Zealand. For this reason every support needs to be given the council in completing its studies.

Communication Protocols

Observation:

16. *There are a large number of communication protocols in use reflecting differing views of manufacturers and an initial lack of internationally agreed standards.*

There is little acceptance of industry standards by manufacturers who optimise protocols for their own equipment, causing a proliferation of non-compatible communication protocols to be supported in New Zealand. This is undesirable as it prevents the integration of networks and sharing of host computers by terminals. It also increases the variety of equipment installed and prevents the purchase of a sufficient volume of any one type of equipment to obtain quantity discounts or to enable local assembly.

As the proposed Post Office packet switching system must connect equipment produced by many different manufacturers, it has been necessary to adopt an overall standard to ensure compatibility. The Post Office commitment to the internationally recommended standard packet switching protocol X25 can be seen as the first step towards rationalisation. All future purchases of communications equipment and related decisions need to consider compatibility with protocols.

Changes in Post Office Data Communication Services

Observation:

17. *The Post Office has been criticised by some data communication users for introducing new services with little warning or consultation, for delays in the provision of lines, and for failing to recognise and remedy customers' line problems. This criticism may not be well founded.*

The Post Office has recently introduced the OASIS system which allows New Zealand subscribers to access two data bases in the United States. Plans are in progress to introduce limited speed lines and packet switching. These moves aim to make better use of existing circuits.

Packet switch networks are not intended to suit all data communication users. In particular, large data volume and fast response systems users would not be handled by packet switching. In addition, many users have extensive investment in equipment and protocols which are incompatible with the X25 protocol necessary for packet switching. The concern expressed by some data communication users reflects a misconception that packet switching is intended as a replacement for existing services. In fact the system aims to provide a more economical service to users with limited data volumes.

The provision of leased circuits is sometimes delayed. This appears to be due to lack of capacity in some locations and shortage of staff in others. Users may themselves contribute to delays if they do not give the Post Office adequate warning of their future requirements, for lengthy lead times are involved in purchasing and installing equipment and cable. The demand for data circuits has increased very rapidly and users would ensure a better service by advising the Post Office as early as possible.

Some customers report difficulty in obtaining action from the Post Office on noise problems and transient faults. Many problems result from the rapid increase in demand for data circuits, which has required most to be carried on lines engineered for telephone operation rather than the more stringent requirements of data communication. While there is an appreciation of the problem at the Post Office transmission centre level, local linesmen cannot all be expected to have a full comprehension of the needs and problems of data circuits. The necessary action may only be achieved after contact with senior Post Office management.

Post Office Tariff Structures for Data Communication

Observation:

18. *There is concern that the Post Office will increase tariffs for existing services substantially to obtain quick returns from new facilities. This concern seems groundless.*

Network design decisions and operating economies are very sensitive to tariff rates which can be altered by the Post Office. The Post Office is to bring in additional data communication facilities with the intention of getting better utilisation through more users sharing lines. While these moves are desirable from a national viewpoint there is concern among existing users that the tariff structures may be altered to achieve an early payback of the cost involved in setting up these new services by discriminating against users of existing services.

The Post Office is concerned that a number of existing customers are disadvantaged by having to pay for lines in excess of their low speed requirements. It has stated that there is no intention of increasing tariffs for existing data communication services to obtain a quick return from its planned new services.

Recommendations:

22. **The Post Office and Government agencies should be committed to a long-term objective of rationalising protocols. This**

objective should be a major evaluation factor during the purchase of all related equipment.

23. Data communication users should actively seek contact and ongoing liaison with the Post Office to ensure co-ordination in the provision of data circuits and the introduction of new services.

CO-OPERATION BETWEEN PUBLIC SECTOR ORGANISATIONS, DATA INTERCHANGE, AND SECURITY

Cost Savings through Co-operation

Observation:

19. *Opportunities exist for significant cost savings and other benefits through co-operation between public sector organisations for the joint use of computer resources, joint development of applications, and exchange of data.*

A small number of public sector organisations operate computer facilities jointly. This has shown that savings can be made by spreading costs between organisations. An additional advantage is that more sophisticated systems may also result, as more design resources are available and experience is pooled. This concept is referred to in the section on computing in local government where co-operative development is most applicable.

When the same information is required for two agencies, it is logical that duplication of data collection and maintenance should be avoided where possible. There are instances where duplicate data is required to be maintained by both central and local government agencies. One of the most outstanding examples is the maintenance of property ownership and valuation information by both territorial local authorities and the Valuation Department. Local authorities initially take copies of valuation information from the Valuation Department's district valuation rolls. Property vendors are required to supply information to both the local authority and Valuation Department with data having to be transferred between the two agencies. Periodically, attempts have to be made to reconcile the two sets of records and this invariably shows discrepancies through the advice from one organisation to the other not having been properly recorded.

In addition to this overlap of data collection and maintenance, there are organisations which have common information needs. Information is often held by one organisation and is either not available or is available in limited form to other organisations. Co-operation, however, has been made possible by the use of computers. Examples are:

(a) Data collected by the Department of Statistics is the base information for several tasks. For example, the statistics for the 5-yearly census of population and dwellings together with land information forms the main data for town and country planning and research into this and many other areas (e.g. housing, transport, geography, and sociology). The department operates a scheme to distribute this information.

(b) Land use information affects the Department of Justice (lands and deeds registration) and departments such as Valuation, Lands and Survey, Forest Service, and Works and Development, together with the whole town and country planning requirements of local,

regional, and central government. Co-operation in the land use information area would be possible by either the utilisation of existing data base information or the establishment of a centralised land use recording system. An enlargement of existing data base information, for example, utilisation of the Valuation Department data base, combined with a degree of contribution and merging of data from other interested departments, could possibly provide sufficient land use information to meet user requirements. Currently, there is a pilot project on the feasibility of a centralised land use recording system which may possibly be a means of meeting the major needs in this area. This would be a very large system, however, and would be subject to the risks and problems explained on pages 62 to 63. Before either alternative is commenced a very careful investigation to ensure the benefits exceed the costs would be necessary.

(c) Hydrographic data is used by catchment and drainage boards as well as the Water and Soil Conservation Division of the Ministry of Works and Development. There is a scheme for sharing hydrographic data and much co-operation between the two levels of government.

There may also be situations where similar computing facilities or data may be required by different public sector agencies in the same location. For example, a catchment authority, a branch office of the Water and Soil Conservation Division of the Ministry of Works and Development, and university researchers. Rather than each group having separate, small computers or using a remote central installation, it may be better to combine their requirements into a single, jointly-financed computer. There may be substantial technical advantages through using the specialist knowledge of the university staff combined with the data available from other participants. Such an arrangement is currently difficult to organise because of the necessity for approvals to be processed simultaneously through two or more different government approval systems.

Opportunities also exist for co-operation between the public and private sectors.

Data Integrity and Privacy

Observation:

20. There is a need for public sector guidelines on data integrity and privacy.

Data integrity refers to the procedures incorporated within any system to protect data from accidental or unauthorised destruction or modification. It refers to hardware, software, system, and personnel controls.

Few public sector computer installations have comprehensive standards for data integrity nor does management have procedures to ensure any standards that exist are followed. Even where data integrity had been considered it was often as an after-thought with controls being added to systems after completion of design. Integrity controls need not result in a large overhead provided they are considered early enough in systems design. Guidelines for data integrity would assist systems designers.

It would be appropriate for such guidelines to be developed for local authorities by the advisory group recommended in this report, and for central government by the State Services Commission.

Privacy is the right of an individual to determine for himself what personal information to share with others. Privacy issues become more important when computers are involved because machine-readable data becomes readily accessible. If further data interchange is to occur between local and central government, a prerequisite will need to be the acceptance of agreed standards for personal privacy. To date, in central government, privacy implications have been considered as aspects of individual systems instead of in terms of general principles. In local government various cases have arisen where the legality of making certain information available has been questioned. As no agreed set of rules exists and data processing staff do not have the protection of an enforceable code of good practice, they cannot readily challenge the integrity of information being made available by their employers for uses not anticipated at the time the data was collected.

The point has been reached where an agreed approach on the privacy issue needs to be adopted. This is best done through the development of agreed standards formalised by legislation. The philosophy for such a code would need to be based on the accepted principles that data should only be used for the purpose for which it was collected and that individuals are entitled to confirm the validity of data affecting themselves.

A recently published Australian Computer Society Code of Good Practice in the Privacy, Security, and Integrity of Data is at present being studied by the New Zealand Computer Society. This could provide a sound basis for New Zealand's development in this area.

Recommendations:

24. Co-operation between public sector organisations through the joint use of computer facilities, the joint development of systems, and sharing of computer-recorded information should be encouraged. Any proposal which would duplicate facilities should be investigated thoroughly.

25. Standards for data integrity should be developed. These should be prepared in the local government area by the recommended advisory group (see Part II, Recommendation 55) and in central government by the State Services Commission.

26. The Government should encourage the development of privacy standards and incorporate these in legislation.

PRIVATE SECTOR SERVICES

The private sector has provided, and will continue to provide, data processing services for the public sector. Commercial bureaux have been particularly important for local authorities. The private sector also provides a variety of services often referred to incorrectly as "consultancy". While these services include consultancy advice, they also cover contract staff to fill vacant positions, contract programming, specialist technical or design skills, and in some cases the complete management and development of a project.

Observation:

21. The success of projects where private sector services have been employed has varied and in some instances the service has been unsatisfactory.

A consultant is a person who provides independent expert advice to an organisation. Consultancy advice has normally been requested for one of two reasons:

(a) to provide independent external advice to management; or
(b) to recommend complete solutions to data processing problems, which may include defining hardware and software requirements and organisational and staffing structures.

Many consultants, because they have been involved in the client organisation for only a short time, do not fully appreciate the particular requirements of public sector organisations. This lack of understanding has led to poor advice and underestimation of the size and complexity of the task. In other instances the advice given was narrowly based and did not take into account a wide range of options. In some cases this was due to the "consultant" having a vested interest in selling a machine or service to the organisation.

Contract staff have been employed for tasks such as analysis, programming, and systems programmer aspects of data base and data communications. Private sector services have been sought where public sector organisations had skill shortages or there were insufficient staff to complete a project on time. Contract staff are costly but can be justified if used for appropriate tasks for short periods. However, managers have employed such staff on tasks where their skills have not been fully used, and have not always clearly defined the work required or set targets and monitored progress. In some cases contractors have been used to fill long term positions. This is not only expensive but causes staff morale problems and does not build up experience among permanent staff needed to provide maintenance of applications.

There have been a few instances where private sector contractors have taken total responsibility for the management of a project. Where the rights and obligations of parties have been clearly defined in a contract and management has closely monitored progress, such projects have been successful. However, others have encountered problems resulting in time and cost overruns. Factors contributing to these problems have included lack of public sector knowledge by consultants, misunderstanding by consultants of Government procedures, and management failure to precisely define requirements. The least successful projects have been where the entire job has been left to the consultant and users have had little involvement.

Private sector bureaux have filled and will continue to fill an important data processing role in the public sector. Bureaux are appropriate where:

(a) There is insufficient data processing expertise within an organisation.
(b) An organisation wishes to avoid the risks of a computer within the organisation.
(c) Data processing is required for short-term peaks and a separate machine would not be efficient.
(d) A bureau has particular expertise.

A bureau service may be cheaper but this needs to be related to the type and level of service.

An advantage of using a bureau is that in some cases the cost of development of a particular application can be spread over a number of

users. This is especially true in local authorities where, for example, one bureau processes 12 rating systems, and 13 electricity billing systems. In these cases, a standard one-time set up charge is made which is considerably less than the cost of developing the complete application. This probably accounts for six commercial bureaux providing 90 percent of processing for local government. However, many of these bureau systems were designed a number of years ago to meet the basic common needs of users. This means they lack flexibility and amendment is a slow process as agreement must be reached with all users.

The level of documentation provided by bureaux is not always of a high standard. Problems have also been encountered regarding the level of service and ownership of applications. A contract should incorporate these points.

Recommendations:

27. **When using private sector data processing consultants, management should ensure the firm employed has the appropriate skills and experience for the assignment.**
28. **When public sector organisations employ contract services, management should ensure they are employed on tasks appropriate to their skills and that progress and productivity is monitored.**
29. **Where private sector contractors undertake complete data processing projects, management should clearly define requirements and responsibility, and closely monitor progress.**
30. **Arrangements for bureau services should be incorporated into a formal contract which covers levels of service, standards of documentation, and ownership of applications.**

PART II
ISSUES SPECIFIC TO EACH CLASS OF PUBLIC SECTOR ORGANISATION

While Part I dealt with general issues affecting all organisations, Part II details the issues which are specific to individual classes within the public sector. In all cases the broad issues and recommendations in Part I are additional to the specific recommendations made in the following sections.

COMPUTING IN CENTRAL GOVERNMENT

The Government could not perform many of its essential functions without the use of computers. The use of computers has released staff from mundane administrative support tasks and allowed them to become directly involved in achievement of the Government's main objectives. It is clear that direct financial savings from computers have recovered the overall cost of all computer resources many times over.

There is no evidence that the quality of data processing staff in central government is any less than in the private sector. Many Government computer projects which have been successfully implemented are of a size which dwarfs all but a few of those in the private sector. This emphasises the need for a high standard of management.

Some of the suggested changes to management systems are not new initiatives by the Audit Office review team. A number of problems have already been recognised by the State Services Commission (SSC) at top and middle management levels. Progress towards solving the problems has been made during the review and has continued since the completion of field work. It is important, however, that Parliament be aware of the problems that exist and the changes that are required, so that active support can be given to the commission in its drive to improve computing in central government.

Background

Central government was first to introduce computing into New Zealand when the Treasury installed a machine in 1960. During the next decade, computing grew as an individual departmental function. By 1969 nine departments had computers with Treasury and the Department of Education acting as bureaux for other departments.

In 1970 it was decided to centralise the two bureau operations into a government computer centre. This was initially set up as part of the Department of Internal Affairs with the SSC handling the policy functions. In 1972 the operating and policy functions were merged to form the Computer Services Division (CSD) of the State Services Commission.

CSD has developed into a highly centralised operation, running four large computer centres and four data preparation centres. The Ministry of Works and Development computer is owned by the SSC but operated by the ministry as a specialist engineering facility. Other large independent installations are operated by the Post Office, Department of Health, New Zealand Railways, and Ministry of Defence.

All these installations have data communications networks, some of which are extensive. Several other departments have small computers, some linked to the main CSD computers.

The SSC is responsible for the largest computer organisation in the public sector and employs about 450 staff in CSD. In 1978–79 CSD spent $16 million in providing services and equipment to departments (including staff costs, capital expenditure, and repayment of capital equipment credits) and received $15 million from the departments. A further $6 million was spent by departments served by CSD on other costs, mainly their own staff. The independent installations spent $14 million in the same period. Overall central government expenditure on computing in 1978–79 was $36 million.

Computing covers a very broad range of applications including planning and optimisation, scientific, engineering, and statistical purposes as well as accounting and administration.

The following examples give some idea of the magnitude of computing in central government:

Income tax—	
deduction certificates matched	6 million certificates annually
refunds	1.2 million payments annually
returns lodged	2 million returns annually
Insurance policies	2 million policy records
Law enforcement system	7 million enquiries annually
Mortgages	300 000 mortgage records
Payroll	155 000 employees paid fortnightly
Property description and valuations	1.2 million records
Road user charges	0.5 million vehicles
Social Welfare benefits	1 million beneficiaries paid fortnightly or 4-weekly
State house rents	60 000 rent records
Superannuation and National Provident Fund	260 000 accounts
Treasury accounting system	3 million transactions annually
Vehicle ownership	1.8 million vehicle records

These examples cover systems run for 15 out of 38 departments and represent a small proportion of the total systems.

The Control of Central Government Computing

Main issue:

1. *The method of selecting new data processing projects, by its very nature, can result in resource allocation decisions which do not necessarily lead to the most effective means of achieving the Government's aims.*

All proposals made by Government departments for additional funds which introduce a new activity, or significantly alter the size, scale, scope, or quality of an existing activity are defined as "new policy" and are required to be submitted to an annual new policy review. Expenditure on data processing has been regarded as a special activity for a number of

years. New policy proposals involving data processing are separated from other departmental new policy and then considered along with data processing proposals from all departments.

As a matter of Government policy, departments initially submit proposals for new data processing projects to the Computer Services Division of the SSC for evaluation of the technical feasibility and the justification as put forward by the individual departments. At this stage many projects are not supported by full costings or estimation of benefits and some proposals are withdrawn after departmental discussions with the SSC.

After the papers presented with each proposal have been studied by the SSC they rank the projects according to their assessment of merit and the general new policy criteria. These criteria reflect the broad aims of the Government to promote employment, exports, etc., but are inappropriate for many computer systems.

Requirements for computer equipment for these projects, together with upgrades and replacements for Government computer centres, are incorporated into a single EDP "new policy" paper. This paper, together with Treasury comments on the financial implications, is submitted to the Cabinet Committee on Expenditure (CCEX). For the last 2 years the SSC has presented a 5-year EDP equipment programme as part of the data processing new policy paper. This may assist CCEX ministers in their resource allocation decisions but will be effective only if it is formally adopted.

CCEX approves in principle which projects are to proceed and then agrees to provision being made in the departmental estimates for the necessary expenditure. Departments are still not permitted to proceed with a project without a "financial authority". This requires more detailed justification and costing by the department. For larger projects, further reviews by the SSC, the Treasury and the appropriate Cabinet committee are required.

The current system does not take into account the value of items. Low value items, such as a single terminal or software lease costing less than $2,000, still require consideration by the SSC and this may be out of proportion to their value. Therefore, the cost of staff resources used by departments and the SSC in the justification process can exceed the actual cost of the data processing resource required.

Some departments which use computers for specialist purposes gain considerable detailed knowledge of the particular resources required for these tasks. Situations have arisen where it is questionable whether the Computer Services Division of the SSC has the necessary skills to evaluate these specialised requirements. Where departments have the requisite knowledge, they may be better suited to making their own evaluations, subject only to financial approvals and co-ordination of purchasing.

The current system places all computer projects together and they are ranked against each other. Other new policy is considered by CCEX on a department-by-department basis and at a different time. This may mean that computer projects receive a different ranking in the EDP new policy paper than the department has accorded the project in relation to other departmental new policies. It is possible for a computer project ranked third by a department to be accepted yet its second ranked policy rejected. In practice, this situation may result in a re-evaluation by CCEX but there is still a possibility of distorting priorities.

Computing is a service function and as such should be viewed as part of

the activity it supports. Computer projects could be reviewed when other departmental new policies are considered and this would seem desirable in order to make the best use of departmental resources. The danger in this approach is that economies from computer proposals due to efficiency may be of secondary importance to the political objectives of the Government. Data processing, as a service function rather than an end in itself, does not directly achieve Government objectives but assists departments to do so. Computer proposals that provide more effective management information systems are worth considering because of the consequent improvement in departmental efficiency and reduction in overheads.

Departments are advised that computer new policy is evaluated on the same basis as all new policy. However, computer projects need to be seen as a means of improving efficiency and should be evaluated on that basis. The SSC recognises this and uses additional criteria relating to efficiency and economy when advising CCEX. Departments are not fully aware of these additional criteria.

In the past CSD equipment upgrades, replacements, and new equipment have been considered along with all other new computer projects. Upgrades and replacements are part of the continuing activity of the computer centres run by the SSC and reflect the development of departmental projects. Provision has to be made for enhancement and replacement of existing computer equipment due to growth in existing applications and obsolescence. Unless a phased plan for replacement is agreed and built into a programme, there could be an unavoidable requirement for very high spending in a single year. Replacement is becoming critical for a number of large computers and this has been recognised and built into the EDP equipment programme prepared by the SSC for presentation to CCEX. The concept of accepting this programme as a formal funding commitment by the Cabinet Committee is still under consideration.

In 1980 some departments have been requested to substitute new policies for existing expenditure of a continuing nature or to trade-off among competing new policies. This applies to both computer and other new policies. However, departments tend to be wary of the risk that, at the same time as forgoing funds for existing requirements, they may also not gain the new project.

While new computer projects are subject to scrutiny the cost of existing systems is seldom calculated. Proposals which might well have greater benefits than computer applications already in operation may not even be identified and put forward by departments. The existing system favours large projects and existing user departments. Existing users have more experience of computers and of the system for selecting new data processing projects. A large project is given more attention and is more likely to receive special work on preparing full justification. Existing users may also be able to escape scrutiny by requesting "modification" to applications already running.

Computer projects are generally well-suited to rigorous cost/benefit justification. Though such studies are often prepared, there are no standards or guidelines for the preparation of costs and benefits information, e.g., measurement of staff costs, accommodation costs, treatment of overheads, intangibles, etc. Not all new policy proposals are supported by detailed studies of costs and benefits. The SSC intends to require better justification for computer projects in future as part of the

introduction of a new methodology. Even where cost/benefit studies are prepared there is no facility for following up to ensure actual benefits are achieved. The recent appointment of a Director of EDP Audit and the recently adopted project control methodology should help provide such follow up.

Recommendations:

1. **The system for consideration of new computer projects should be altered so that computer proposals are considered along with other departmental new policy proposals.**
2. **Independently of Recommendation 1, the following changes need to be adopted:**
   - **(a) Procurement procedures should be scaled to reflect the amount of resources involved. Purchase approvals required to be given by the State Services Commission should be given at the lowest practical level. All departments should receive appropriate financial delegations for expenditure on low value items. Departments making specialist use of computers should receive wider delegations.**
   - **(b) A subset of new policy criteria should be devised for EDP projects. These should more closely reflect the role of computers as a service function.**
   - **(c) Approval procedures should be streamlined to avoid double presentation to Cabinet committees of all but the very large projects.**
3. **The EDP equipment programme developed by the State Services Commission should be refined and submitted for decision by ministers to ensure a planned programme of replacements.**
4. **Active support should be given to managers to make better use of funds by substitution of computer projects for other new policies or existing expenditure.**
5. **Centrally prescribed standards for cost/benefit studies on computing projects should be developed and all proposals submitted to ministers supported by such studies.**
6. **Departments should be required to conduct formal post-implementation reviews measuring actual costs and the extent to which anticipated benefits have in fact been realised. These reports should be subjected to confirmation by the EDP audit group. For major projects these reports should be sent to the State Services Commission, the Treasury, and ministers.**

The Roles of CSD

Main issue:

2. *The Computer Services Division of the State Services Commission is seen as having the conflicting roles of:*
   - *(a) Advising departments on the data processing implications of policy and administration.*
   - *(b) Advising the Government, the Treasury, and departments on the technical feasibility of projects, evaluating the justification provided by departments, and providing limited planning assistance.*
   - *(c) Providing the operational data processing services.*

   This means that operational considerations may unreasonably dominate the evaluation. Departments do not see that advice given to the Treasury is objective.

Inset 6

The same staff in CSD are responsible for advising departments, vetting new policy proposals for computer projects, and evaluating requests for financial authorities for computer expenditure.

CSD handles a very high volume of data processing proposals from departments each year—178 for 1980–81. Although existing staff spend a lot of their time perusing the proposals there are insufficient staff to properly review each submission. After some evaluation by CSD and discussion with departments the majority of these proposals are withdrawn. In 1980, this left 45 to be considered by the Cabinet Committee on Expenditure.

In addition to reviews under new policy, reviews are required at the time financial approvals are sought for purchases of individual items of equipment and minor items requiring CSD approval, e.g., purchase of terminals, expenditure on EDP training courses for CSD centres, use of private sector software packages. Thus, staff tend to spend most of their time on control functions, rather than acting as consultants to departments. Current personnel do not consider they have been properly trained to carry out the control functions or that these should be combined with their service functions.

For those reasons, CSD staff are not able to provide departments with an adequate advisory service. This would not be such a disadvantage if all departments had their own analyst staff. However, there is a shortage of staff with analyst skills in departments. There is a need for staff with both technical knowledge and experience of departmental operations. Earlier schemes for providing systems planning staff in departments failed because positions were too lowly graded and the staff lacked detailed departmental experience. CSD has since been working with departments to encourage development of these skills within departments. Some degree of external expertise, to provide top management with independent advice, to supplement the skills of departments, and to support less experienced users, will always be required.

The advice to the Treasury in its role of reviewing computer projects proposed by departments is provided by CSD staff. Departments consider CSD expenditure proposals for hardware compete with departmental data processing projects for the limited funds available. CSD initially ranks new computer projects for the Government and the Treasury without the necessary detailed knowledge of departmental activities. Users are critical of CSD for its conflicting roles in this area. However, management support groups in the SSC and the Treasury contribute to the advice to the Government, and departments, of course, have the opportunity of putting their case to CCEX. User departments need to be aware of the necessity for control over the resources used for computing. The controls exercised should be viewed in the light of scarcity of skilled manpower.

CSD also acts as an adviser to the Treasury on computers purchased by wholly Government funded local authorities including education boards, hospital boards, technical institutes, and universities. While CSD staff have technical EDP skills, they do not have the background knowledge to carry out this task which requires an appreciation of the data processing needs of the organisations affected.

As CSD is the sole source of service available to departments who do not have their own installations, the latter are almost always required to

use a CSD centre without the alternative of seeking private sector services. Applications are allocated to individual centres by CSD, and departments often feel they have been inadequately consulted.

CSD already makes considerable use of private sector organisations for development work, particularly contract work for sections of large projects. There is merit in expanding this option for some projects, especially where the private sector has the required specialist expertise or there is a need to supplement staff and machine resources. Steps would be needed to ensure adequate control by departments over the compatibility of systems, and secrecy and privacy issues. The Government would also need clear contractual arrangements to cover continuity of service and adjustments to pricing. The private sector would need to be prepared to accept the commercially less attractive Government projects as well as other tasks. To ensure that CSD would not have an unfair competitive advantage it would have to meet full private sector costs for equipment, buildings, etc. Even with full costs, CSD rates would probably be cheaper unless the private sector supplier had a particularly innovative solution. It is logical that where CSD is cheaper, or quotes the same price as a private sector source, departments should be directed to use the Government facility. This assumes the two options are comparable in quality and time scale for implementation.

In summary:

(a) CSD advisory staff spend the majority of their time on control functions rather than providing an advisory service.

(b) Departments feel that CSD does not have the knowledge of departmental operations to fairly rank projects.

(c) Departments feel that CSD has a vested interest in allocating work to its own centres without considering private sector options, especially for small projects.

These conflicts can only be resolved by separating the three functions currently performed by CSD (i.e., control, advisory, and operations).

Recommendations:

7. **A more comprehensive consulting service for data processing needs to be provided to management in departments. This should be supplied by full-time officers within departments, supported by data processing advisory officers from a restructured Management Services Division of the State Services Commission. The advisory officers should perform both the advisory role and the initial technical feasibility study of new computer projects. To ensure advisory officers can perform these tasks properly, they should not be burdened with any control functions. Officers engaged in the advisory and technical evaluation tasks should be interchangeable with systems development staff. Care also needs to be taken that these officers keep up to date with new technological developments.**

8. **Both the State Services Commission and the Treasury have a role in advising the Government on EDP projects. The SSC responsibility should be to rank projects according to their potential to improve administrative efficiency within departments. The Treasury should comment on the broad financial and economic implications for central government. Both**

agencies need to ensure they have the technical capability to evaluate computer projects without reliance on advice from the operational area.

9. There are several alternative forms of organisation for data processing operations and systems development provided centrally to user departments. These are:

(a) A separate operating division within the State Services Commission.

(b) A separate agency.

(c) A Government services department combining data processing operations with other central service functions.

Whatever form of organisation is chosen by the Government, it is important that the control function be separated from the operations and the advisory role.

10. Departments should be given more flexibility in using the private sector as an alternative to the central government computer centres, where the private sector has specialist expertise and is cheaper. Such an option should be available only after consultation with the restructured Management Services Division of the State Services Commission. The division should ensure adequate provision is made for long-term support of the applications, if a private sector alternative is chosen.

Large Computer Centres

Main issue:

3. Current Government computing relies on a few large centres. While the policy of centralisation was common some years ago, this may no longer be the best solution in all cases due to the overheads of large machines and changes in the relative cost structure. Little effective back-up exists to ensure the continued operation of essential applications in the event of local problems or disasters.

Some Government systems will always require large computers, either where a single, centrally-updated data base is necessary or because of the large scale of the tasks.

The desirability of a small number of large computers has tended not to be questioned, as additional applications have usually been allocated to existing centres. This has had four effects:

(a) Continued growth of centres that are already very large with consequent pressure for upgrade.

(b) Applications allocated to large centres without full consideration of the best hardware option.

(c) Tasks for individual centres dependent on available short-term capacity without necessarily having full regard to the suitability of the particular centres.

(d) Some of the resulting workload, which comprises small applications that could be economically run on small mainframes or mini-computers, occupying capacity better suited to the large applications being developed.

The SSC has recently formed an inter-departmental advisory committee to consider tasks such as the definition of a philosophy for size of machines in relation to type of application. The committee needs to consider whether it may now be appropriate for more hardware to be

located within individual departments. The effectiveness of this committee would be improved if its role was formalised and its membership included persons external to central government.

There is a proliferation of brands of large machines which creates excessive overheads in trained staff and support. Each brand of machine has special features which require highly trained staff, who are not interchangeable between centres without retraining and lost productivity during the learning period.

Each of the large computer centres supports a network of terminals together with communication lines. There may be economies through reducing the number of data communication protocols. This would allow sharing of data circuits and higher use of dedicated communication lines.

There are ten large computer installations in central government, four of which are unique within New Zealand. Machines unique within the country are less likely to receive adequate support from vendors whose operations in New Zealand may not be large enough for sufficient highly skilled staff to be trained for a sole site.

Some past decisions have involved pioneering new technology in New Zealand both for hardware and software. This can cause delay and additional cost, and increases the risk of failure; such decisions, involving substantial risk, require special consideration and good management.

A further consequence of using a small number of large computers is that back-up of individual centres becomes more difficult. This problem could be reduced through greater standardisation of machines and the location of more centres at different sites throughout the country.

The large central government machines have spare capacity overnight as there is a tendency towards interactive systems which create a day-time peak load. This spare overnight capacity could be used by such people as university researchers if there were compatible equipment and the necessary communications links.

Recommendations:

11. **The philosophy for central government computing must be regularly reviewed to ensure that the number, size, and location of computer installations is optimum with regard to the changing relative cost structure and current technology. This should be a task for the new inter-departmental advisory committee on EDP which should have a wider membership.**
12. **A policy should be developed to ensure tasks are implemented on the appropriate sized machine rather than being automatically allocated to a centre. Where it is considered appropriate that a task be undertaken at one of the established centres, CSD should ensure the task is allocated to the most suitable rather than the most convenient centre.**
13. **Future procurement should seek to standardise on a limited variety of large computers irrespective of manufacturer to reduce problems of skilled staff and support. Pioneering equipment unproven world-wide should be avoided and equipment unproven in New Zealand should be carefully evaluated.**
14. **The number of communications protocols should be reduced, leading to higher use of dedicated communications lines and fewer terminal types.**

15. Improved back-up for large computer installations should be sought through greater standardisation of machines and the location of more centres at different sites throughout the country. Formal contingency plans should be maintained on a recurring basis to ensure continued operation of systems in the event of local problems or disasters.

16. Spare mainframe capacity should not be wasted but be made available for non-critical tasks at incremental cost to Government agencies and at a fair market price to other users.

Long-Term Planning and Procurement

Main issue:

4. There is no approved co-ordinated long-term plan for central government computing. This is an essential prerequisite for the proper and cost effective use of computers.

There have been a number of attempts to prepare long-term plans for central government computing, but these have not been formally accepted by the Government, even in principle. To provide an incentive for a proper plan to be developed and used, greater interest needs to be shown at top official and ministerial level, with some commitment that the plan will be used if accepted by the appropriate Cabinet committee. The SSC has developed a long-term equipment programme but this tends to concentrate on hardware needs rather than individual departmental projects. Such a programme could be built into a long-term plan but some level of funding commitment would be required.

Past decisions have tended to be dominated by short-term pressures due to the uncertainty created by the annual new policy review. Planning has generally been treated within the context of computer centre requirements rather than flowing from individual comprehensive departmental plans. Planning for computers is also hindered by a lack of clearly stated objectives by all levels of management. Planning for computers should not be in CSD, where computing is seen as an end in itself, but should be developed from decisions on how departments are to achieve the objectives of the Government.

Some computer purchases are not presently co-ordinated by CSD, e.g., accounting machine replacements, data loggers, and word processors. While in the past many of these were "stand alone" machines, this is now frequently not so. Word processors and minicomputers for accounting may be identical to "intelligent" terminals linked to larger machines. These, as well as data loggers, frequently pass information to or from other computers. Word processors may need to be compatible with computer typesetting equipment. Though there are informal systems of liaison between the various control groups, this would be better handled by a single organisation to ensure consistency.

Economies in purchasing, through volume discounts, are hindered by the lack of long-term plans and clear policies on future development and funding. The 1980 new policy documents included the basis for a capital equipment programme for computers, though there is no formal commitment for funding in future years. If sufficiently large orders of equipment were co-ordinated, it may be possible to attract vendors to establish local assembly plants to reduce foreign currency costs and provide employment. It may also be possible with high value orders to

obtain offset arrangements to write software locally, either by the vendor increasing staff in New Zealand, or by placing contracts with the private sector. Such arrangements exist in Australia.

Purchasing staff have only limited training in contract negotiation. This is wholly inadequate for the magnitude of purchases. Purchase terms and conditions in contracts vary with each individual purchase, and there are no guidelines for the terms which should be included. Performance criteria and maintenance conditions have not always been incorporated in purchase contracts at the time of negotiation. However, a recent large purchase established a good precedent by setting out performance criteria in the tender specifications which were later incorporated in the contract.

Recommendations:

17. **Comprehensive long-term plans for both systems development and computer equipment should be developed within departments, co-ordinated by the State Services Commission, and incorporated into a rolling 5-year programme. The existing State Services Commission computer equipment programme should form the basis for such a programme, supplemented by departmental requirements. This programme should be approved by both top officials and ministers in a manner similar to the Capital Works Programme.**
18. **The State Services Commission should be responsible for co-ordinating procurement of all computer hardware unless it is an integral part of other equipment. This co-ordination should be restricted to issuing guidelines for procurement procedures, organising offset arrangements, and negotiating bulk purchase contracts. Departments should then be able to purchase equipment within these guidelines with the minimum of administrative overhead, especially for low-value items under bulk purchase contracts.**
19. **Staff involved in negotiation of computer purchase arrangements should be specially employed for this work, and trained to a level appropriate to the value of purchases involved.**
20. **Standard terms and conditions, including performance criteria and maintenance conditions, should be developed for inclusion in all Government computer tender specifications and later incorporated in contracts.**

Project Development and Control

Main issue:

5. *Some large data processing projects have had problems resulting in budget overruns and performance well below expected standards. One of the major problems has been poor project management.*

There are insufficient trained project managers. Many managers for major projects have not been placed high enough within the management structure to communicate effectively with all top-level managers. There has been a tendency for project managers to be orientated towards pure data processing rather than user requirements.

There has frequently been insufficient commitment from top-level user management. Where top management has become involved there is a better success rate and fewer problems in satisfying users and meeting targets.

Ministers and senior officials have not always appreciated nor been adequately advised of the time needed to implement Government policy decisions which are reliant on data processing. For example, the road user charges system had to be designed before the legislation was finalised and, as a consequence, has had to be rewritten.

Projects have had to be commenced before user specifications were agreed and these have had to be modified during design and even programming. This reflects a grave shortage of business analyst staff in departments who are capable of adequately defining their requirements, as well as poor project management.

Projects have often been developed as very large units, for example, with a time span of 3–4 years, rather than in manageable modules of no more than 12 months' duration.

Adequate assessment of the resources (hardware, software, and personnel) required for projects has not been carried out on many occasions. Neither has the adequacy of these assessments been regularly reviewed throughout the development period of long projects.

The effect of these problems has been time and cost overruns and inefficient or unworkable applications being implemented, requiring excessive maintenance and subsequent rewriting.

These problems have been recognised by the SSC and a project control methodology was purchased in 1979. This methodology is being progressively implemented now and should provide the means of eliminating problems prevalent in the past. It must be recognised that substantial efforts are required to support any project control methodology and to be effective it must be adopted as a central government standard. A project control methodology is not a substitute for good management, but is an aid to the competent project manager.

Recommendations:

21. **Ministers, when contemplating the early introduction of policies which require the development of new systems or major changes to existing systems, should ensure that they are fully aware of all the data processing and cost implications.**
22. **It is essential that no new projects be commenced within central government without the adoption by all levels of management of a project control methodology such as the one recently acquired and introduced by the State Services Commission.**
23. **No project control methodology will work unless the right type of officer is appointed and trained as project manager. The State Services Commission should ensure that, before any project is commenced, a suitable and highly skilled project manager is appointed.**

CSD Operations and Service Role

Main issue:

6. *The quality of service to user departments provided by the different computer centres of the Computer Services Division is uneven. Many user departments have expressed dissatisfaction.*

Of the four centres run by CSD, two handle a small number of large users and provide very similar types of service to each of these users. The other two are general purpose centres supporting a large number of user departments. The two former centres have a significantly higher degree of user satisfaction. There is an inverse correlation between the number of users with similar service requirements and levels of service and satisfaction.

Contact between centre staff and user departments varies widely. Liaison with users is uneven and user departments' views on its effectiveness vary accordingly. CSD is developing a scheme to improve user satisfaction through setting and monitoring standards of service. The scheme is presently operating at one centre.

Two centres have entered into contracts with user departments for a small number of applications. These were commenced as pilot projects but have not progressed further. Other than these, there are no formal contractual agreements for the development, maintenance, and operation of applications covering minimum agreed levels of service and the rights and obligations of the parties.

There are no consistent standards for all centres covering development, documentation, and operations. Individual centres are not subject to independent reviews of operations which would help reduce variations in standards.

The CSD charge-out rates are inconsistent between centres, and therefore a task processed at one centre could cost a different amount at another. As CSD decides which centre will process an application, users have little control over the cost of service provided. Charge-out rates for centres are varied over the life of hardware. This has normally resulted in high initial charges while loadings are light, followed by substantial reductions as the load factor increases. The need for a more consistent charging policy has been recognised by CSD and a new policy is being developed.

The full potential from systems performance evaluation has yet to be realised at three out of the four CSD centres. As the centres are not static, with frequent alterations to hardware and the mix of applications, management should recognise that tuning needs to be a continuous process. CSD management states that lack of staff with the required high level of training and experience prevents them from instituting more formal systems of performance evaluation.

The skills of tuning are relatively machine-independent. Different software monitors are required for various machines but hardware monitors can be used on any machine. Although the likely savings from the use of a hardware monitor are considerable in comparison with its cost, CSD does not have such a tool. Earlier proposals to purchase one were dropped, as CSD felt that staff would not be available to properly use it.

Gains are also available from tuning frequently-run applications programs. Where this task has been undertaken, the gains have approached 20 percent of the total machine running costs. While this may

reflect substantial gains from an initially inefficient situation, it also shows the potential for improvements generally.

The desirability of providing internal audit coverage of EDP has been recognised by the commission and the position, Director of EDP Audit, which was created within CSD some years ago, was filled in February 1980. Further staff need to be appointed. The function of the EDP Audit Section should be to provide a management-type internal audit, including reviews of individual computer centres, monitoring the implementation of standards, and all matters of conformity to management's requirements. Consistent with modern internal audit philosophy, the positioning of such a review function should not be within an operational division but should be seen as a reporting service for top management. No agreed guidelines for data security exist for central government computing. The new EDP Audit Section is the obvious group to co-ordinate this development.

Recommendations:

24. **Comprehensive standards set by CSD management for all computer centres must be developed. These should cover the following key areas: user liaison, levels of service to clients, charging policy, documentation, development of applications, maintenance, reliability, and timeliness of production. These standards must become the basis for a formal contractual relationship between CSD and users, and to this extent the experiments already carried out in this area by the division are to be encouraged. A policy should be set which will ensure that each centre is appropriately staffed for the number of clients it serves, so it can provide the level of service required by its contracts.**
25. **A specialist team should be established with responsibility for systems performance evaluation at CSD centres. This team should be equipped with a hardware monitor and visit each centre in turn, reporting to CSD management. Frequently-run application programs should receive regular efficiency reviews.**
26. **The Director of EDP Audit should perform a management-type internal audit function, carrying out an independent review of all computer policies in central government, and should report directly to the member of the State Services Commission responsible for EDP.**

Cost Responsibility

Main issue:

7. *The method of charging for computer services to individual user departments does not ensure departments are encouraged to use the available computing resources in the most economical manner.*

A manager should be accountable for the resources under his control and this should be reflected in reports on the costs incurred. This concept requires the measurement of the full costs as an incentive to act efficiently and conserve resources.

Departments are charged for equipment used and services provided by

CSD. As CSD sets the departmental budgets for expenditure on data processing and then recovers the amount through service and equipment charges, there is little incentive for departmental management to actively control this expenditure. This position reflects an attitude that "transfers between departments do not matter as no cash is involved". This attitude is fallacious as real costs in terms of machine and staff time are incurred by CSD to enable it to provide user services.

There are some inconsistencies in financing expenditure on computer equipment. While the majority of capital expenditure is met from CSD's budget, items are also purchased directly by departments. Where departments have their own computers, they tend to regard the internal service as of little consequence in terms of cost and therefore do not closely control its use. All departments spending funds on computing, including transactions by way of inter-departmental transfer, need to be fully accountable for the cost.

Departments would be made more responsible for the cost of computer services provided by CSD if charges were negotiated as part of contracts of service. CSD would be in a better position to justify charges if it were made a trading operation with published accounts similar to the Government Printer. At present CSD prepares only internal management accounts which are not published.

Greater cost responsibility within CSD and departments could be achieved by the establishment of a "revolving fund" outside the normal Vote accounting system, recovering costs by charges to departments and using these funds to finance operations and equipment. Parliament would retain control by approving the data processing expenditure of client departments. Any funds required by CSD for expansion would be appropriated by Parliament and ministerial control would still be exercised over the capital equipment purchase programme. Accountability would be displayed through published audited accounts.

Recommendations:

27. Irrespective of the future organisational arrangements for computing in central government, the CSD computer centres should operate on the following financial basis to improve management performance in the centres and user departments and to provide greater accountability for centre performance:

(a) The computer centres should be removed from the normal Vote accounting system and operate on the basis of a revolving fund in accordance with the following principles:

(i) Full recovery of all application development, application maintenance, hardware, and operations costs (including amortisation of equipment and interest on capital).

(ii) Cash thus generated to be retained in the fund to meet costs of operation and capital expenditure without Parliamentary appropriation (see below).

(iii) Parliamentary appropriations for computer operations to cover costs borne by departments and any additional finance for the revolving fund where computing is to be expanded.

(b) Agreed financial objectives for CSD should be set by the Government. Some possible objectives are:
  (i) Break-even after all costs.
  (ii) Provide an agreed proportion of capital expenditure from a cash surplus generated from annual operations.
  (iii) Provide an agreed rate of return on capital.
(c) Annual accrual-based accounts should be prepared, audited, and published in a report to Parliament.
(d) Regular accrual management accounts should be prepared and furnished to centre managers, comparing actual performance with budget.
(e) Control by ministers and control agencies over the level and nature of computing services should be exercised by:
  (i) Selecting new computer projects to be implemented for user departments.
  (ii) Setting the level of funding for computer expenditure by user departments.
  (iii) Requiring user departments to regularly review the efficiency and effectiveness of current data processing operations.
  (iv) Approving capital equipment enhancements, replacements, or additions, to be purchased out of the CSD revolving fund.
  (v) Approving any additional finance for the revolving fund where computing is to be expanded.
  (vi) Determining staffing levels of CSD operations.

28. Departments operating their own computers should follow cost responsibility principles by instituting costing systems and charging user sections for data processing. This would allow users to properly compare the alternatives of using either their own department's computer or the CSD service.

COMPUTING IN THE HEALTH SERVICES

The Department of Health computer project described in this section commenced in 1975. Since that time there have been many staff changes and a number of crucial technical problems which have prevented full implementation. It should be noted that current staff are attempting to operate systems and improve a situation which in many cases was not of their making.

The problem, fundamental to the health project deficiencies, was that New Zealand Government management systems in use in the mid 1970s were not sophisticated enough to oversee a project of this complexity and magnitude. There is no suggestion that any individual officer is personally accountable for all of the problems which have arisen. Rather than a further review, efforts should concentrate on solving the known problems through involvement of top management and technical staff, with the assistance of outside expertise where necessary.

Introduction

The Department of Health (DoH) Data Processing Division operates two regional data centres and a head office group employing in total 150 data processing staff. The function of the division is to provide data processing for the health services including systems development and operational and technical services.

The current situation results from a co-ordinated approach to data processing taken in 1975 for the 29 hospital boards and the department. Prior to 1975 a National EDP Committee (Health) had been set up to try to rationalise the development of computing in the health services. Funds were made available to three boards for the development of systems which were to become the basis of nation-wide systems. Auckland was to concentrate on payroll, North Canterbury on biochemistry laboratory, and Otago on patient admission/discharge.

This approach failed to rationalise the situation so overseas consultants were employed to advise on a reorganisation of EDP in the health services. They were then employed to implement the recommendations contained in their report. This envisaged:

- A separate data processing division within DoH to serve the 29 hospital boards and the department.
- The division having a Head Office in Wellington, with regional data processing centres in Auckland and Christchurch.
- Each data processing centre serving half the country, operating identical systems via a data communications network to their respective users. The centres were to be coupled by high-speed lines to provide back-up and to maintain a split data base for the admission/discharge system.
- The design and implementation, at a prototype site, of three core systems and a procedure for nation-wide installation. These three systems were to be:

  Payroll—which in its implemented state includes personnel recording and manpower budgeting.

  Admission/discharge—which holds relevant patient information and provides management information and statistics for better hospital use.

  Clinical laboratory—to provide acquisition and processing of test results for 8 laboratories.

- Existing applications servicing the various boards being converted to run on the department's computers.

Although staff have put a great deal of effort into developing the core systems they are still not implemented by all boards. It was intended that systems would be implemented by December 1977.

The degree to which systems have been implemented is as follows:

IMPLEMENTATION TO DATE

	Payroll	*Admission/ Discharge*		*Clinical Laboratory*		*Converted Systems*
	Most Staff	*Phases I and II*	*Phases III and IV*	*In Test Mode*	*To be Extended to*	*Some Systems Available*
1. Ashburton	...	...	...	...	...	...
2. Auckland	...	X	...	X	X*	X
3. Bay of Plenty ...	X	...	...	...	...	...
4. Cook	X	...	...	...	...	...
5. Dannevirke	...	...	...	...	...	...
6. Hawke's Bay ...	...	...	...	...	X	...
7. Maniototo	...	...	...	...	...	...
8. Marlborough ...	...	X	...	...	...	...
9. Nelson	...	X	X	...	...	...
10. North Canterbury ...	...	X	X	...	X	X
11. Northland	X	...	...	...	...	X
12. Otago	X	X	...	...	X	X
13. Palmerston North ...	...	X	...	...	X	X
14. South Canterbury ...	...	X	...	...	...	...
15. Southland	...	...	...	...	...	...
16. South Otago ...	...	...	...	...	...	...
17. Taranaki	...	...	...	...	...	...
18. Taumarunui ...	...	...	...	...	...	...
19. Tauranga	...	...	...	...	...	...
20. Thames	X	...	...	...	...	...
21. Vincent	X	...	...	...	...	...
22. Waiapu	...	...	...	...	...	...
23. Waikato	X	...	...	...	...	...
24. Waipawa	...	...	...	...	...	...
25. Wairarapa	X	X	X	...	...	X
26. Waitaki	...	...	...	...	...	...
27. Wanganui	...	...	...	...	...	...
28. Wellington	...	...	...	...	X	X
29. West Coast	...	...	...	...	...	...
National Health Statistics Centre...	...	†	...	...	...	X

*2 hospitals

†Obtains information from those boards using the Admission/discharge system.

Implementation is well behind schedule and cannot proceed significantly unless some serious technical problems can be overcome.

The health services project has been subjected to a number of reviews. While some of these reviews expressed concern, not all of the relevant

issues were addressed. Of the points raised, only some of the recommendations have been actioned.

In 1976, a Special Advisory Committee on Computer Re-organisation within Health and Hospital Services (sometimes referred to as the Atkinson Committee) was set up to report to the Minister of Health on the applicability of core systems, the methods and procedures adopted, cost effectiveness, and the future benefit of the project.

In relation to the terms of reference the committee considered the core systems were appropriate, but recommended they should be related more directly to patient care. They criticised the lack of public relations and the lack of involvement of medical personnel. The committee considered it could not comment in detail on cost effectiveness but felt that the systems would materially assist the health services in the future. Comment was made on the advantage of having a separate statutory organisation for the project. The committee also suggested the consultants' report should have been more widely circulated.

Reasons for the early delays are given in a 1978 report of the Systems Development Planning Review Committee. This internal committee consisted of representatives of the health services. It noted that the delays had been due to a deferred start time, a Government review which delayed recruitment, extensions to the scope of systems, and the late delivery of software and teleprocessing network equipment. The report stated that in broad terms the project was 12 months behind schedule at that stage.

In those boards where the core systems are in full use the administrative and medical information produced from the applications is an invaluable tool and justifies the concept of systems developed especially to suit the health services. However, the stage has now been reached where positive and detailed steps need to be taken to determine the future direction of the project.

Control of the Health Services Project

Main issue:

8. *Difficulties have been encountered in the control of this project and, while the events are now historical, this experience needs to be documented and lessons noted, so that such situations are avoided in the future.*

Control of a project of the size and complexity of the one DoH undertook in 1975 is a major task. Total commitment of user and development staff, a feasible time scale with achievement targets, strict discipline over all development activity, in-depth assessment of technical issues, detailed monitoring, and a management which is able to react should any problem arise, are all prerequisites for success.

Throughout the health project there has been difficulty in reaching agreement between the development staff and some users. With a large number of users it was hard to reach complete agreement before design work commenced. As a result, changes were made in an attempt to meet all perceived user needs after completion of the initial design and even after computer programs were written. Computer system specifications need to be prepared and agreed upon, then frozen for the duration of development. However, a system can only remain frozen if it represents a successful general solution to user requirements. There is still disagreement over the latter as potential users were led to believe that systems were going to be capable of meeting all their needs.

The implementation of the core systems requires major effort by hospital board staff. During implementation there was insufficient warning of the heavy workloads and structural reorganisation necessary to obtain full benefits. The result has been a traumatic experience for boards and satisfaction is only now growing from a very low base. Pre-implementation reviews of existing procedures in all boards by DoH staff are now carried out before any application is installed. These studies sometimes recommend changes in staff structure and management approach but boards do not always implement these changes before the computer systems are introduced.

The payroll system was extended to incorporate personnel recording and manpower budgeting. The system produces a large number of reports though it is not immediately obvious to boards how this information should be used. Responsibility for input and output needs to be decentralised within boards along with budgetary control if the full benefits are to be realised. The admission/discharge system also requires a substantial conversion task and some reorganisation of medical record keeping procedures. An overlap of manual and computer systems is necessary under phases I and II. In these phases National Health Statistics Centre information is produced, which boards find of significant assistance. However, full benefits are not realised, and the need for overlap of computer and manual systems eliminated, until phases III and IV are adopted.

Projects of this size need to be broken down into controllable modules with achievement of specific targets and deadlines as prerequisites for further development. It was acknowledged that the original estimates did not, in hindsight, accurately reflect the magnitude of the task. This was in part due to expansion in scope of the systems. The delays in implementation reflected not only this change in scope, but also the deferment of tenders for equipment and staff recruitment during the 1976 review and what may have been over-optimistic estimates of the time needed for developing individual applications. There were also technical difficulties which are discussed elsewhere.

Some tasks were commenced and resources committed when the required staff were not available and assumptions were made regarding availability of equipment which were later found to be incorrect because of technical difficulties. The division has never been able to recruit staff to fill all established positions. At present, 30 percent of positions are vacant. This is a higher level than any other large installation in central government and the remainder of the public sector. The major vacancies are in analyst and systems programmer positions.

At lower management levels it appears there was not sufficient monitoring of the standard of work and achievements. Some positions were filled by personnel without the appropriate skills. There were inadequate lines of communication and responsibility. The combination of these factors led to the need to rework tasks and contributed to missed deadlines. The lack of strict discipline for applications development led to poor coding. Current staff are working to improve documentation and the efficiency of some program code.

Subcontractors were used on the project, and while this is expensive, they can sometimes play an invaluable role if properly managed. However, these contractors were not always given quantifiable tasks with criteria for division management to measure performance, and they were often used on tasks inappropriate to their skills.

Project management reports to DoH top management referred to technical problems and noted, at least in part, the likely effect on the whole project. Detailed corrective action was generally not suggested. DoH top management acknowledge that they did not have the knowledge to understand the technical complexity of the project and the need to become involved in decision making and formal monitoring beyond studying the reports received. What advice they did receive internally was not always adequate and sometimes conflicting. The possibility of obtaining independent advice was considered but the DoH felt this was not available and that they could rely on their consultants.

In hindsight, there are areas where better control would have avoided many of the subsequent problems. Project control procedures were developed and followed for the early part of the project but later lapsed. The necessity of project control has been recognised within data processing circles for many years and generally accepted principles have evolved. Various proprietary systems or methodologies encompassing these principles are available. The Department of Health management have recognised the necessity for project control and are now adopting the project control methodology recently purchased by the State Services Commission. It must be stressed that this methodology package is a management tool and does not reduce management responsibility.

Difficulties in Further Implementation

Main issue:

9. *The Department of Health Data Processing Division will not be in a position to give a commitment to any further significant implementation until the fundamental problems regarding the department's credibility with potential users, the data communications network, operation of the mainframes, and application efficiency are solved.*

The inability of DoH to give and meet formal dates for implementation has left the hospital boards in a critical dilemma. At present, many boards are trying to exist using cumbersome manual systems, accounting machines past their economic life, earlier generation computers, or short-term interim bureau systems. These do not provide adequate management information to satisfy current conditions. There is considerable anxiety as to whether the nation-wide systems will be available before their own systems collapse.

Although the 13 hospital boards using one or two of the core systems are satisfied with the service received, given the problems DoH are experiencing, the status of the entire project among other boards is extremely low. The project's credibility can be redeemed only by steady implementation of core systems. This implementation is dependent on the resolution of the technical issues which are mentioned below.

The data communications network will not work in the form originally intended because only interim network software has been deployed and it does not support payroll. The vendor's network software was not supplied until July 1979, 2 years after target date. This late delivery affected the entire project and was the direct cause of some of the project problems. The requirement for the software may have been too ambitious and it appears that the software suffered from being relegated in status by the vendor. However, the vendor did provide additional machine resources in an attempt to overcome the problem in the short-term.

The two main core systems were developed at separate computer centres without sufficient regard for the operational requirements of the other centres. During the 2-year delay an interim network software solution was developed to run the admission/discharge application. Work diverged to the point where applications requiring access to a network were no longer compatible. Work is now proceeding in an attempt to correct this incompatibility. The Christchurch centre currently runs the admission/discharge system for all eight users, and payroll for three boards. The Auckland centre runs payroll for five boards and cannot run the admission/discharge system. Payroll data collection still has to be run directly into the mainframe. This requires a substantial portion of memory and each mainframe can only support six terminals concurrently, a small proportion of the number intended.

DoH management decided in March 1979 to adopt the vendor-supplied software as the single solution but they were unable to enforce implementation of this decision. However, as a first step towards general use, the vendor-supplied network software, with minor amendment, is now being implemented at one board. This would still leave incompatible network software operating into the two computer centres, although some work is being done towards implementing the single solution. Had the interim software been written to the same specification this incompatibility would not have occurred. Unless there are valid technical reasons why DoH management's decision of March 1979 should not be supported, the chosen network software solution should be fully implemented and the necessary conversions made. The latter must be done with a view to using all possible economies in such a conversion, both in terms of conversion effort and later machine use.

The Department of Health mainframe computers are not achieving the anticipated throughput. Part of the problem has been the inability to deploy a network. There is a continuing controversy over whether the mainframes are suitable for the batch task required of them. Auerbach, an internationally recognised reference, states of the mainframes used that "the continuous processing of batch high priority jobs, such as those required in a commercial shop, is almost impossible." The vendors, and individuals with relevant experience, dispute this and claim that there are adequate benchmarks overseas to prove that the machines can effectively handle batch tasks, if properly configured. The controversy must be solved. Overseas batch operations using these mainframes need to be studied to determine whether modifications can be adopted here. There has been inadequate systems performance evaluation and tuning, but current DoH staff have worked to develop some basic performance monitoring tools.

Different machines are designed with attributes more suited to some tasks than others. Such attributes and drawbacks of the existing mainframes have not been properly taken into account during development, and therefore several applications make grossly inefficient use of machine time. The payroll system takes significantly more processing time than normal for an application of this type. With peaks on two nights a week for the batch tasks, there is little capacity to allow any significant expansion to further boards, unless payment dates are altered, which is not considered feasible.

The payroll system currently pays about 15 000 staff, approximately one-quarter of hospital board employees. This application is based on a payroll package which was severely modified. This, together with the fact

that some of the modifications were poorly done, led to an application which has bad code and inadequate documentation, and operates inefficiently on the DoH equipment. Further modification of the payroll system could well be uneconomic and may not be feasible. The future of the payroll is being assessed at present. The scope of this exercise needs to be wide enough to include consideration of a rewrite of the system, the possibility of using the computing power of the network minicomputers, and moving non-critical payroll processing functions away from the peak processing periods.

The admission/discharge application seems to run reasonably efficiently but there have been suggestions by current technical management within the division that some sections may require rewriting. If a single software solution was introduced admission/discharge could run on both centres, but to provide a single national data base it would have to run on a split data base, a concept which is not yet proven to be feasible.

The clinical laboratory system was made feasible only by redesigning the system so that the minicomputers on-site for network switching were used to take the majority of the processing load, and by locating microprocessors in the laboratory to handle data acquisition. The system is fragile and will probably need high maintenance support. Unless some hospital boards are willing to use the laboratory system in the form in which it currently exists, continued operation of this application cannot be supported.

The Embargo on Hospital Board Computing

Main issue:

10. *The embargo placed on development of computing systems prior to the commencement of the initial consultancy study has prevented justified growth of data processing in parts of the health services, particularly medical research.*

Computing is becoming an important aspect of medical analysis, and some laboratory equipment currently being marketed includes microcomputers as an integral part. Although the embargo on computers within hospital boards has now been partially lifted, it has meant that some of these needs are being met by higher cost methods.

Criticism has been made that nation-wide systems are weighted toward administrative support rather than medical analysis. There is no doubt that the systems do provide medical information and significant long-term benefits affecting the level of medical care. However, the embargo placed on development outside the core systems may have had a detrimental effect on the advancement of health care in other areas. It may already have led to distorted resource allocation decisions within the hospital boards when use of computers cannot be considered an option.

Some of the converted systems provide computing outside the administrative field. Boards have experienced some difficulty in obtaining access to the converted systems once they have been modified to run on the DoH main computers. Even when these systems are running on DoH equipment, operational changes have been difficult to obtain as these systems compete with the core systems for resources.

Expertise exists in some hospital boards to develop small to medium systems. Technicians now have exposure to data processing in their training. Other medical staff get some data processing training here and from study overseas. Some board staff have by-passed the embargo by

purchasing microcomputers under the guise of scientific equipment. Small computers have also been purchased from research funds. These are generally sub-optimum solutions requiring greater programming effort than co-ordinated development on more suitable equipment. However, much of this work could be of considerable benefit to other boards if they were aware of its existence.

Boards do not seem to fully appreciate that the embargo has been partially lifted. This was advised in a DoH circular dated early 1979. The criteria laid down in this circular for evaluation of proposed local projects are restrictive in that they preclude systems which are:

- within the scope of existing systems being provided by the department;
- within the scope of a project or system planned for development by the department in the foreseeable future;
- likely to be duplicated elsewhere within the hospital services or the department.

Free rein is not envisaged but local projects could be supported while maintaining some control over larger machine purchase decisions.

The Future Direction of Computing in the Health Services

Main Issue:

11. A decision has to be made as to whether the continuation of the health services project can be economically justified and, if so, whether the managerial and technical problems can be overcome.

In 1975 when the project was commenced the total budgeted expenditure was $25.8 million.

	$(m)
Outside personnel costs	9.6
Health personnel costs	5.9
EDP equipment	3.7
Travel	1.1
Other equipment, facilities, supplies, etc. ...	2.1
Planned contingency	3.4
	25.8

In 1978 a consultant's report showed that adjustments for inflation would take this figure to $40.9 million. It also stated that actual expenditure to 30 September 1978 together with 1979 and 1980 budgeted expenditure was $28.8 million. The latter showed $7.5 million for hardware, which included network equipment, and $2 million for maintenance. Actual expenditure reported in the Estimates for the past 5 years, together with loan credits outstanding, means that the total cost has now reached $30 million. The question is whether this amount is justifiable in relation to the number of boards who have access to the system.

Detailed cost/benefit studies were not completed nor were records kept of costs for each application compared with costed benefits. However, boards that have fully implemented the core systems, and the National Health Statistics Centre, have clearly identified benefits. Cost savings have been achieved, information has been made available more quickly,

and staff are starting to realise the benefit of improved efficiency through the use of better management information. In a time of financial constraint some board executives consider they could not do without the information provided by the systems. Central development of systems avoids each board having to develop its own system and provides better maintenance support.

If it were possible to project the benefits being gained by boards currently using the systems through to the other boards, the $30 million spent would probably be recovered and the central development of systems for 29 similar users would clearly be cost effective. For these reasons, it is considered a controlled attempt should be made to place the project on a sound footing. However, a detailed cost/benefit study needs to be undertaken so that future decision making can be undertaken on the basis of sound information.

The need to have total user support for the development and implementation of any system has already been stressed. For the DoH Data Processing Division to obtain hospital board acceptance in the future and to provide co-ordination for the development of the systems other than the nation-wide systems, the division needs to be seen to be part of hospital board operations, and not part of a central government department. The division would have greater support from boards if it was independent of DoH and was subject to control by a management board which had hospital board representation and some technical expertise. However, before an independent identity can be established the managerial and technical problems as well as the financial viability of the project must be addressed and resolved.

The present organisational structure within the division is not appropriate. The allocation of functions between the division's Head Office and the two centres has caused communication problems and in some cases hindered the implementation of top management directives. Situations also arise where Head Office personnel are domiciled at one centre but control staff at the other centre.

There is also the lack of a top level technical director. At present the position of Director EDP is vacant and the Assistant Director has resigned. In the past the division has had a non-technical head. However, the complexity of the project requires a director who has detailed experience in large systems and proven managerial ability.

The director needs to be supported by at least one other highly skilled technical person and by a competent senior officer who would handle contact with central government agencies. Depending on the needs seen by the director, extra specialist skills may have to be obtained for particular tasks, for example, the modification of the mainframes operating software. In the longer term, the number of staff in the division will need to be reviewed as there is reason to believe the current establishment could be reduced. The primary objective of the director must be to implement solutions for the current technical problems described in Main Issue 9.

At the same time that a workable management structure is devised, the operational structure of the centres needs study. The organisational problems would be reduced, the need for a split data base for the admission/discharge system would be eliminated, and problems with the network would be reduced if there was a single production centre. Whether the other centre is maintained for development would be dependent on a study of the long-term economics of such a move.

There has been some dispute over whether existing mainframes are obsolete; they are certainly not of recent design. They can still be run for some years, however, and should not be considered as being past their economic life. The concept of using a network based on large central mainframes has been challenged. At present the proven technology is not available to totally disperse the processing for the admission/discharge system but elements of the payroll system could be run on a distributed processing principle. The cost performance of such an approach needs to be continually monitored as part of long-term planning.

To protect the resources already committed, targets need to be set so that if the project is not near full implementation within 12 months it should be subject to review. If the project can be made to run successfully it would then be appropriate to pass it over to an independent body with a board of management made up of hospital board representatives.

Recommendations:

29. A decision should be made on whether a controlled attempt should be made to place the project on a sound footing. This would require:
(a) A change to the organisational structure to facilitate strong management decision making.
(b) The appointment of an experienced technical director together with the support staff necessary.
(c) A cost/benefit study.
If further significant implementation is not achieved within 12 months further commitment to the project should be reviewed.

30. Serious consideration should be given to setting up the present data processing division as a separate body under the control of a management board, representative of hospital boards and including either one or two members with technical expertise.

31. Full support should be given to the complete implementation of the project control methodology recently purchased by the State Services Commission. Senior Department of Health management, data processing division management, and hospital board management should be committed to meeting their obligations for project control.

32. The suitability of the existing mainframes to handle the task required should be determined by comparison with existing use elsewhere. If they are found to be suitable, adequate steps should be taken to tune them to handle batch tasks.

33. A single network software solution should be fully implemented. The necessary conversion of software should commence immediately.

34. The existing payroll application should be either redesigned or replaced.

35. The laboratory system should be abandoned unless some hospital boards accept the system in its current form.

36. Implementation of individual systems within boards should proceed only after the recommendations in pre-implementation reviews have been adopted.

37. Once the scope of the nation-wide systems has been re-defined, the Department of Health should encourage hospital boards to submit proposals for "stand-alone" systems, outside the scope of the nation-wide systems, where these can be shown to be the most cost-effective answer to their requirements. Where it considers such proposals to be appropriate, the department should support them and set standards for their development.

CONTROL OVER LARGE COMPUTER PROJECTS

When large projects are developed over a period of several years, there is great potential for failure. This can lead to large amounts of expenditure with little benefit achieved. It is necessary to set up and monitor large projects carefully to avoid this. While the introduction of project control should assist at the project level it is still necessary for the approving body to monitor the situation closely.

Procedures need to be followed in a similar manner to those used for other large expenditure projects, such as engineering construction, which also face lengthy development periods and uncertainties. These procedures should not be short-circuited. In the case of the Department of Health it appears that some procedures were not strictly adhered to and while this may have led to a faster set-up time it did not result in faster total implementation. Any project should be under the direct control of a highly skilled manager who can be held accountable for the success of the project. This manager needs to represent the end user to ensure requirements are met as well as the technical success of the project.

In the control of a large data processing project there is a need for some form of regular independent review. This should be timed to coincide with the completion of each significant phase with a maximum of a year between each review. Such a review should be by a person independent of the project team who can, without spending a great deal of time, confirm that the project is proceeding according to plan. A report on such a review should be made to the approving body, e.g., for central government, Cabinet or the appropriate Cabinet committee.

In any large data processing project there is a need for the project to be authorised and monitored in discrete phases of time and cost. Approval to proceed to a subsequent phase needs to be contingent on successful completion of the previous one with expenditure approvals given by the approving authority for each phase.

In larger projects there is often a lack of emphasis on formal cost/benefit studies. Even where a project's benefits are wholly intangible, e.g., better health care, the costs should be calculated and amortised over the expected life of the applications. There needs to be formal agreement at the start of the project that the value of intangible benefits exceeds the costs over the estimated life of the applications.

During the health project expenditure was not related to the successive achievement of physical goals. As expenditure did not exceed the initial 1975 assessed total project cost, and the level of achievements in relation to expenditure was not monitored, there was no mechanism in operation requiring the approving body to be informed of the detailed effects of project slippages. The monitoring of time and costs to actual achievements is an essential element of project control.

Recommendations:

38. Before any new large computer projects are undertaken a detailed project control methodology should be adopted as a standard. Such a methodology should provide for: top level management involvement; regular monitoring; highly skilled project manager; adequate and competent staff; operational level management review; sound design work; user commitment and support; proper use of sub-contractors.

39. Large computer projects should be authorised and monitored in discrete phases of time and cost. Approval to proceed to a succeeding phase should be dependent on the successful completion of the previous one. Large computer projects should be subject to independent review at least once a year with the results reported to the appropriate approving authority.

40. Large computer projects should be required to recover set up and running costs over their life time. Every project should have a cost/benefit study completed before approval, and this then used as a yardstick during development. Staff should be required to report significant cost increases or delays in implementation dates to the approving body and to obtain a renewed approval before proceeding.

COMPUTING IN EDUCATIONAL INSTITUTIONS

Introduction

Most educational institutions will ultimately require access to computing facilities even if on a relatively small scale. These include universities, technical institutes, community colleges, teachers training colleges, education boards, and secondary schools. Educational institutions are autonomous bodies with mainly locally-elected boards and only indirect control by the Department of Education.

The computing requirements of each university are served by five large computers purchased in the early 1970s supplemented by a variety of smaller machines. These large computers are near the end of their economic lives and will shortly need replacement. The Government has recently approved funding for a replacement programme and technical evaluations are being conducted at present.

Technical institutes have a variety of small machines, some of which have been donated. They also run jobs on machines operated by universities, private firms, and government computer centres.

Computing in secondary schools is provided for seventh form students through an arrangement with a private company. This is supplemented informally by equipment donated or purchased from local fund raising and time made available by private firms and universities.

Very few of the remaining institutions make significant use of computers at present.

A Comprehensive Policy for Educational Computing

Main issue:

12. *The Department of Education has a broad outline policy for the computing requirements of educational institutions other than universities. This outline has not yet progressed into a comprehensive policy for the full range of educational institutions encompassing administration, teaching, and research and has not been agreed by top officials and the Government. There is no clearly defined responsibility for teaching the various aspects of computer related studies.*

The University Grants Committee co-ordinates requests for funding university data processing. Other educational institutions deal directly with the Department of Education. Development of a policy for the computing requirements of educational institutions commenced within the department in 1979. A departmental committee has been formed which also includes technical advisers from the Computer Services Division of the State Services Commission. This committee aims to co-ordinate computing requirements, other than for universities, and the purchase of hardware and development of software where possible.

Prior to this co-ordination there was a diverse approach by individual organisations. Some computers, for example for education boards, could be purchased without consultation with the department provided a special grant was not required. A standardised approach to education board computers and software is planned by the department.

Technical institutes also were proceeding with individual plans. Two institutes were operating remote job entry stations linked to a large central government computer centre. This link cost one institute $80,000 in 1979 for the processing needed to teach programming to 24 students. A co-

ordinated approach for technical institute computing is now emerging. The Government has recently approved new computers for teaching in technical institutes. The first phase of this policy will eliminate the remote job entry links to the central government computer centre.

University computing falls into three distinct categories—administrative, teaching, and research. Administrative computing is done on the large computer at three of the universities and on smaller dedicated machines at the remainder. Teaching of students is also being served in a variety of ways, with a trend towards separate machines with terminals to allow direct keying of jobs. Research is a problem as the demand tends to expand to absorb available capacity.

Universities are funded by block grants for each 5-year period known as a quinquennium. It is clear that the method of funding university hardware purchases has an effect on the level of spending. The original purchase of the five large computers was from a special grant of $3.4 million. This grant covered the machines only. Staff and other recurring costs were met from existing block grants. During the 1975–79 quinquennium all computing costs were to be met from the block grant which was not adjusted for inflation. The result was expenditure of $6.75 million on staff, $4.20 million on recurring costs, and $2.45 million on hardware. The 1980–84 quinquennium excluded provision for computer hardware, and a separate phased programme of $5.13 million for hardware has recently been approved. Funding this expenditure is now being dealt with through the University Works Programme. Planning for computer equipment purchases is aided by a programme of expenditure, though this would be better as a rolling 5-year plan rather than linked to the quinquennium.

Computing is having an increasing influence on many aspects of life and there is a growing requirement for training and education for computing. There are common elements to computer related studies regardless of the level being taught. Courses need to be structured so that work completed by students at lower levels can be built on later without the need to relearn basic steps. This would increase the effectiveness of the limited teaching resources available for such courses. This applies particularly to courses at secondary schools and technical institutes.

The section on personnel and training (see page 16) discussed the requirement for a changed emphasis in university courses on data processing. The recommendations in that section should be read in conjunction with this section. The course requirement for universities is more diverse and a number of parallel streams of computer teaching are required to ensure the teaching is relevant to the different disciplines.

While the Department of Education has begun consultation on some individual syllabus requirements, there is a need to clearly allocate responsibility to different institutions. This will require more permanent consultative arrangements than at present.

While the department has made some progress in co-ordination, there is a requirement for a broadly-based advisory mechanism drawing upon expertise outside central government.

Recommendations:

41. The Department of Education should form a broadly-based advisory committee for EDP, drawing members from the public

sector, including educational institutions, and the private sector. The committee should help formulate policy proposals for both the provision of computing resources and the allocation of responsibility for teaching different computer related courses.

42. The Department of Education's broad outline policy for computing should be developed into a more comprehensive policy for the computing resources of technical institutes, community colleges, teachers training colleges, education boards, and secondary schools. This should encompass both administrative and teaching requirements. The policy should be reflected in a rolling 5-year plan for hardware purchases which should be agreed by both top officials and ministers.

43. The comprehensive policy, covering computing resources for university administrative, research, and teaching requirements, developed by the University Grants Committee, should be integrated with the Department of Education policy to ensure consistency. University computing policy should also be reflected in a rolling 5-year plan for hardware purchases, outside the quinquennium, which should be agreed by both top officials and ministers.

44. A co-ordinated syllabus for all levels of computer related studies for technical institutes and secondary schools should be developed immediately through the Department of Education in consultation with interested user bodies.

Common Software Development

Main issue:

13. There has not been formal co-ordination of software development to meet the common needs of educational institutions. Co-ordination is now being encouraged by the Department of Education for technical institutes and education boards.

Each university has developed most of its own administrative systems, the majority of which are specially designed rather than packages. Some of these systems are run on the main machine and others on dedicated registry minicomputers.

The differing arrangements have hindered the considerable economies from shared software development. Under shared development each system would probably be more sophisticated and flexible than those individually developed yet the total cost would be less. The current restraints on non-academic staff in universities may make such co-ordination an economic necessity. While many systems are already in operation, the opportunity for sharing should be explored when new systems or major modifications are considered. This will require regular meetings between university staff to ensure awareness of systems being developed.

Some technical institutes have started to organise individual development of modules of a comprehensive administrative system. If this scheme is supported by all institutes the result should be a satisfactory and easily maintained system at very low cost.

The Department of Education plans to use a range of systems developed for one education board as the basis for a common software requirement for other boards. Another education board which provides accounting services to a large number of secondary schools has already

shown that a single minicomputer using common software can provide a cheap, reliable ledger service.

Recommendation:

45. Within each group of educational institutions, the advantages of shared software development should be realised. This will require compatible hardware at each institution but will allow each organisation to retain operational control and develop some software for specialised requirements.

Co-ordinated Hardware Purchases

Main issue:

14. Until 1980 there was little co-ordination of hardware purchases other than for the large university computers in the early 1970s. This has hindered shared software development and possible mutual communication links.

All universities have a computer committee to oversee hardware purchases but the status of these groups and the frequency of their meetings varies widely. There are also variations in purchasing and planning policy. Some universities ensure rigid compatibility of all hardware while others encourage a variety of machines. Similarly, some committees develop detailed forward plans while others wait for funds to become available and approach planning as a 1-year exercise.

Some universities have been able to acquire small quantities of additional resources for computing through barter deals in which the university provides either software development or machine time in return for operations staff, equipment, or software. Although barter deals provide universities with additional resources, they jeopardise future flexibility because of the commitment resulting from the arrangement. Research and other grants may also be used to purchase computers. The University Grants Committee requires computers purchased from research grants to be subject to the approval of the relevant university director of computing. This may not happen for grants from other sources. Both these arrangements tend to result in fragmentation of effort.

In some areas the Department of Education is moving to co-ordinate purchases. New equipment for technical institutes is proposed as a co-ordinated hardware leasing arrangement. The same will probably also apply to education board computers.

Computers will be required as accounting machine replacements for many of the other institutions. When funds are provided for secondary schools there will be orders for a significant number of microcomputers.

Recommendations:

46. The Department of Education advisory committee on EDP, already recommended, should co-ordinate computer hardware procurement for education to limit the variety of machines and allow economies of bulk purchasing. This would assist software development, maintenance, and the transfer of staff and students.

47. Each university should co-ordinate all computer hardware procurement through a computer committee and between universities through the University Grants Committee and the Vice-Chancellors' committees system.

Supplementing University Computing Resources

Main issue:

15. There are some university tasks which require large computers or access to specialised software. It is unlikely that very large computers or specialised software could be individually justified at each university.

If administrative and teaching requirements are largely handled separately, there would be a lesser need for large computers at each university. The majority of research tasks could be handled by a medium-sized computer. There are some tasks which require large machines or access to specialised software. It is unlikely that this software could be individually justified at each university, though some could be if restricted to some universities rather than all. However, the machines which support this software and have the capacity for large jobs are at the central government centres. The development of interactive systems also means that these large machines have overnight spare capacity and this is likely to remain the long-term position. Access to this computing power is, or will shortly become, technically feasible as communications protocols are developed to enable a type of computer commonly found in universities to operate as remote job entry terminals to the large machines.

Recommendations:

48. University research computing should have access to the spare, off-peak overnight capacity of the large central government centres, with safeguards for data security. This could be especially suitable for batch research tasks.

49. Where high cost specialist software is required, consideration should be given to university use of software at central government centres. Where such collaboration already exists, consideration should be given to expansion of the service. Alternatively, it could be purchased by a single university but used also by staff and students from others.

COMPUTING IN STATUTORY BOARDS AND CORPORATIONS

This section covers primary products marketing boards, other statutory organisations like the Accident Compensation Commission, statutory corporations like the Broadcasting Corporation, and wholly Government-owned companies. These organisations employ approximately 450 data processing staff and spent $9.7 million in 1978–79 on computing. They possess computers valued at 21 percent of the total in the public sector. Their intended purchases over the next 2 years amount to only 11 percent of stated public sector intentions. This reflects a long experience in the use of computers by the larger of these organisations, consequent high penetration of computer use and levelling off in the demand for more equipment.

Computing in statutory boards and corporations is characterised by a wide range of applications. Many are specific to the functions of the organisations.

There are a number of factors which make their data processing operations more like those of commercial companies. They have experienced similar problems to those identified throughout this report and the recommendations in Part I apply.

They have been able to minimise the effect of these problems by the use of additional resources at short notice. This may involve employing extra staff, hiring consultants, or purchasing additional hardware. This is possible as boards and corporations do not have the lengthy approval processes that exist in central government and are able to readily adjust budget allocations.

Their managers have tended, through a commercial orientation, to be more aware of the strengths and limitations of data processing.

Several boards and corporations have made extensive use of consultants. Their experience has generally been more satisfactory than in the remainder of the public sector. This is probably indicative of the closer relationship of applications to the commercial experience of the consultants.

There are fewer vacancies and staff have more years' experience in data processing sections of these organisations. Most recruitment is of experienced staff from the private sector.

COMPUTING IN LOCAL GOVERNMENT

Introduction

This section covers borough councils, city councils, county councils, district councils, regional authorities, catchment boards, education boards, electric power boards, harbour boards, licensing trusts, and pest destruction boards.

The initial computing requirements of most of these organisations were met by computer bureaux. The experience gained from these services and the fall in hardware costs led to a growth in facilities within organisations. Currently, the value of computers owned by local authorities represents 18 percent of the total value of computers in the public sector.

The following indicates the exposure of local authorities to data processing as at 30 September 1979:

	Percentage of Organisations Using These Facilities
Non-users	38
Bureau users only	25
Computer within the organisation only	25
Both computer and bureau users	12
	100

The facilities within organisations range from very small, unsophisticated computers to medium-sized machines.

Local authorities employ approximately 800 data processing staff. During 1978–79 they spent $13.1 million on computing, mainly on staff, bureau charges, equipment maintenance, and leasing costs. The traditional requirement has been for financial applications and the majority of effort has been in this area. Other application areas include electoral rolls, libraries, scientific/engineering, and port container tracking.

Local government computing is not homogeneous. There is a wide range in the size of installations and marked variations in standards. This is the result of reliance on the ability of individuals within the data processing area with little top managerial direction or interchange of systems between local authorities.

The Role of Top Management in Computers

Main issue:

16. Few top managers in local government have the necessary training and experience of computers to fully plan and control data processing resources.

Generally, top managers in local government have not had computer experience nor have they undertaken training to compensate. Data processing tends to be placed within the finance section. There is generally little formal reporting by data processing managers and little contact between them and top management.

Data processing staff seldom seem able to present their case without resorting to technical terminology which is either not understood or misunderstood by top management.

A consequence of this situation is that elected members may not be adequately advised on the feasibility and time constraints of data processing systems affected by their decisions. For example, differential rating has been adopted by some councils without consideration of the time needed for the programming required.

Elected members seem to be apprehensive about decisions they are required to make on computer purchases. They tend to take disproportionate time over these decisions though the amounts of expenditure involved may be small in relation to other items.

Recommendations:

50. Top management in local government should receive sufficient training in data processing to enable them to take an active role in the planning and control of data processing resources. The Local Government Training Board should be encouraged to make provision for suitable training in data processing as part of management training courses.

51. Elected members should ensure that they are adequately advised on the data processing consequences of their decisions.

Duplication of Applications Development

Main issue:

17. There has been extensive duplication of applications development effort by individual local authorities.

The development cost of computer applications is generally over half the cost of establishing an installation. These costs may be reduced through using common software. However, co-operation with software development amongst local authorities has been rare.

This may be due to two factors. Firstly, local authorities are self-governing autonomous units and each tends to regard its systems as having unique characteristics. Secondly, the wide proliferation of machine makes and models has discouraged local authorities from using common software.

The result is that there has been considerable wasted effort in authorities developing their own software.

The following table shows the number of common applications which have been separately designed by local authorities:

Application	*Planned*	*Under Development*	*In Operation*	*Total*
Ledger	8	4	55	67
Payroll	3	3	47	53
Power billing	1	2	16	19
Debtors	4	6	41	51
Rates	2	1	27	30
Electoral rolls ...	–	4	16	20
	18	20	202	240

It is obvious that in the local government field large cost savings would be possible if there were more standardisation of applications and a greater degree of joint involvement in their development.

There are, however, some examples where local authorities have combined efforts in systems development. One city council has sold software to two other cities, allowing them to establish in-house computing at a reasonable cost. Seven central North Island electric power boards are co-operating in the development of an on-line power billing system, and catchment boards are also combining to develop a water resource system.

Co-operation is likely to result in a more sophisticated, more flexible system which provides better management information. Cost and risk are also reduced. In the future, with increasing staff costs, there will be even more reason for a joint approach to software development.

Recommendation:

52. Local authority associations should take an active role in promoting the sharing of existing software and the co-ordination of future developments.

Applications Development Standards

Main issue:

18. The approach to applications development varies widely. In half the installations visited users were not sufficiently involved at critical stages of development.

In most local authority installations, formal standards for applications development have not been adopted. In many cases documentation is either non-existent or of poor quality. This is highly risky because detailed knowledge of applications is held almost exclusively by individual staff members.

To ensure a system is accepted and properly used, involvement by the user is essential. In the majority of local authorities, development is initiated within the data processing section. User involvement is often limited to a brief discussion to ascertain requirements. Users rarely formally approve a systems design or conduct their own testing.

An important part of any development is post-implementation review to ensure the system is operating as expected. Applications should be reviewed regularly, to ensure they are still necessary, effectively meeting user requirements, and running efficiently. Such reviews are best undertaken by independent data processing staff in conjunction with the end user.

Recommendation:

53. Local authority data processing installations should adopt formal standards for applications development, relative to the size of installation. These standards should lay down acceptable levels of user involvement and documentation. Responsibility for the development of standards suitable for local authorities should be with the advisory group suggested in Recommendation 55.

Staffing

Main issue:

19. The effect of loss of data processing staff is of greater significance to local authorities than to the rest of the public sector. The small numbers employed within organisations means greater dependence on individuals.

There is heavy reliance by small data processing sections on the systems knowledge and technical expertise of individuals. In any one section there may be only a manager/analyst/programmer, assisted by a programmer or trainee programmer.

To support operations, it is frequently necessary for this function to be performed by the more senior staff to cover sickness and leave. When this occurs all other functions suffer.

Many local authorities have had difficulty in recruiting staff. For example, one council spent $12,000 and 2 years unsuccessfully advertising for an analyst. Some of the factors affecting recruitment difficulty are geographic isolation, lack of promotion opportunities within the organisation, poor image in the view of data processing staff, some pay rates below market levels, and the desire to recruit only trained staff. The most successful recruitment has come from within the organisation. These people have a wider understanding of the functions of the authority and an appreciation of user needs.

Recommendation:

54. Local authorities should recognise the risk of reliance on a small number of data processing staff. Steps should be taken to spread knowledge and expertise among a wider range of staff to ensure continuity. Documentation should be adequate to allow continuous operation and ease of applications maintenance in the event of loss of key personnel.

Procurement

Main issue:

20. The lack of technical expertise in some local authorities has meant that procurement decisions have been made without sufficient regard to all relevant criteria.

Many local authorities do not have the staff able to give the proper technical advice for procurement decisions. Some have obtained advice from other organisations, individuals, computer specialists, consultants, or chartered accountants but it has been difficult for managment to find advisers who appreciate local government needs. In some cases advice has not been reliable and poor decisions have at times resulted in unique, unworkable, unsupported systems.

The most important stage at which objective and sound technical advice is required is in the early stages of the development of a system. Sound technical advice can be crucial in the following areas:

(a) Evaluating whether data processing is likely to be cost-effective in meeting the organisation's requirements.

(b) Evaluating the technical validity and accuracy of cost information of the options available and other factors which need to be

considered (e.g. reliability, maintenance, ease of expansion, or conversion).

(c) Advising which hardware/software, bureaux options most suitably meet specific organisational requirements.

Local government management expressed a real desire to have a reliable, independent source of advice. Advisory groups have already been established in Britain and New South Wales. The British Local Authorities Management Services and Computer Committee mainly provides assistance through published guidelines and conferences. In New South Wales a management services unit has been formed by the Local Government and Shires Association under the control of a joint committee. Members of the unit provide a consultancy service at minimum cost. Such a service is needed for local government in New Zealand.

Good contracts are an important part of any purchase. Many local authorities have signed contracts which omit performance evaluation criteria and maintenance. Maintenance agreements typically range between 8–12 percent of the initial purchase price. Some local authorities have been surprised by subsequent maintenance charges being higher than anticipated. This reinforces the need to negotiate these points and incorporate agreed performance levels and maintenance provisions within the main contract. Similarly, bureaux contracts need to include service levels.

Recommendation:

55. A specialised consultancy group should be established to provide local authorities with technical advice on computer systems and equipment. The appropriate local authority associations should promulgate the establishment of such a group.

Preoccupation with Accounting Applications

Main issue:

21. Application development has been concentrated in the basic accounting area rather than also servicing the potentially more effective areas of planning and optimisation.

Accounting applications make up more than 80 percent of computer resources used throughout local government. This is reflected in the traditional placement of data processing sections within the finance division. The preoccupation with accounting applications has resulted from an attitude of regarding computers in the limited role of replacements for machine accounting systems.

A few authorities have extended computer use into areas such as engineering, town planning, libraries, water resource management, and port container tracking. These authorities are realising significant benefits from such systems.

Many staff in areas outside of finance recognise the advantages of computerising some of their tasks. In a number of cases they have been denied access to their authority's computer.

In some cases specialised software suitable for local authorities is available in central government, e.g. engineering design which is used on

some local authority projects especially where central government funds are provided. Access to such software would be beneficial to a wider range of local authorities.

Recommendations:

56. Data processing sections should be recognised as a service function to the whole organisation. The EDP function should be organisationally separated from operating sections and report to the member of top management responsible for management services.

57. Recognition should be given to the potential of the full range of applications to improve effectiveness of the whole organisation.

58. Access to specialised central government software should be expanded to a wider range of local authorities.

APPENDIX 1

TERMS OF REFERENCE

Objective

To report to Parliament on the current level of use of computers within the public sector and the extent to which management is efficiently using and properly controlling these and related resources.

Terms of Reference

(1) To establish by survey—

(a) Public sector computing facilities in terms of quantity and cost.

(b) The manner and extent of current use of these and related resources.

(2) To review, in respect of significant users, management procedures for—

(a) Planning data processing requirements and controlling acquisition of resources.

(b) Ensuring economic use of these resources while at the same time providing a service to users.

(c) Setting and monitoring standards for the development, documentation, and maintenance of applications.

(d) Ensuring satisfactory controls have been instituted to maintain the integrity and to guard against the fraudulent or irregular use of data.

APPENDIX 2

LIST OF ORGANISATIONS VISITED

1. Central Government Departments

Agriculture and Fisheries, Customs, Defence, Education, Energy, Forest Service, Government Life Insurance, Government Printing Office, Health, Inland Revenue, Justice, Lands and Survey, Maori Affairs, Police, Post Office, Public Trust, Railways, Scientific and Industrial Research, Social Welfare, State Insurance, State Services Commission (Computer Services Division and Cumberland, Pipitea, Trentham, and Wanganui Computer Centres), Statistics, Transport, Treasury, Valuation, Works and Development.

2. Local Government

Cities: Auckland, Christchurch, Dunedin, East Coast Bays, Gisborne, Hamilton, Hastings, Invercargill, Manukau, Napier, New Plymouth, Palmerston North, Porirua, Timaru, Waitemata, Wanganui, Wellington, Whangarei.

Boroughs: Kapiti, Masterton, Tawa.

Counties: Ashburton, Eketahuna, Southland, Tauranga.

Electric Power Boards: Auckland, Bay of Islands, Central Waikato, Egmont, Horowhenua, Hutt Valley, North Auckland, North Canterbury, Poverty Bay, Rotorua Area, Tauranga, Wairarapa, Waitemata, Wanganui—Rangitikei.

Harbour Boards: Auckland, Bay of Plenty, Lyttelton, Northland, Otago, Wellington.

Hospital Boards: Auckland, Nelson, North Canterbury, Otago, Waikato, Wairarapa, Wellington.

Universities: Auckland, Canterbury, Massey, Otago, Victoria, Waikato.

Technical Institutes: Auckland, Central Institute of Technology, Christchurch Polytechnic, Wellington Polytechnic.

Bureau: Computer Consultants Ltd.

Other: Auckland Regional Authority, East Cape Catchment Board, South Auckland Education Board.

3. Statutory Boards and Corporations

Accident Compensation Commission, Broadcasting Corporation, Apple and Pear Marketing Board, Dairy Board, Fire Service Commission, Wool Board, Pork Industry Council, Shipping Corporation, Tourist Hotel Corporation, University Grants Committee, Waterfront Industry Commission.

4. Other

Commission for the Future, Communications Advisory Council, Post Office Union, Public Service Association.

5. Private Sector Computer Installations

Canterbury Frozen Meat Co. Ltd., Challenge Corporation Ltd., Databank Systems Ltd., Firestone Tire and Rubber Co. of New Zealand Ltd., Idaps Computer Science (NZ) Ltd., Northern Trustee Computer Bank Ltd., Shell New Zealand Holding Co. Ltd., Winstones (NZ) Ltd.

APPENDIX 3

SUBMISSIONS FROM MAJOR COMPUTER SUPPLIERS, SOFTWARE HOUSES, N.Z. COMPUTING SERVICES ASSOCIATION AND N.Z. COMPUTER SOCIETY

The following organisations submitted their views to the Audit Office on the use of computers in the public sector:

Burroughs Ltd.
Computer Consultants Ltd.
Control Data New Zealand Pty Ltd.
Digital Computer Science (N.Z.) Ltd.
IBM New Zealand Ltd.
Idaps Computer Science (N.Z.) Ltd.
International Computers (New Zealand) Ltd.
NCR (N.Z.) Ltd.
The New Zealand Computer Society
The New Zealand Computing Services Association
Sperry Univac Computer System

These submissions are summarised below and do not necessarily reflect the views of the steering committee or review team.

A. The Issues Raised in the Majority of Submissions

1. New Zealand has a shortage of trained data processing staff.
2. Educational institutions should provide students with greater exposure to EDP and expand training in data processing.
3. There is a lack of understanding of data processing at top-management levels.
4. A significant level of user involvement is an essential element for successful development of computer applications.
5. Proper project control procedures with senior management commitment and involvement at crucial stages is essential for all new projects.
6. Computer hardware costs have decreased and this factor has increased the importance of making the best software decisions.

1. *Staffing*

It is widely acknowledged that there is a continuing shortage of data processing staff in most areas. Specifically, shortages are more prevalent in the areas of project management, systems analysis, and programming.

Data processing has experienced a relatively rapid natural growth over recent years and the introduction of computer technology into any organisation demands the employment of people with new skills. The skills required are wide-ranging and have to be applied to such activities as problem definition, analysis and design, programming, testing, installation of systems, and operation and management of systems.

The varying skills acquired from involvement with data processing are most probably more universally portable than those in other specialised fields. The skill is more related to the computer than to particular applications and this resultant portability contributes to a high movement of people involved with computers. There is a high loss of New Zealand computer skills to Australia and Europe.

The problems arising from this shortage of skilled staff can be summarised as:

- Delays in implementation of beneficial computer systems.
- Inefficiencies of operation.
- Under-used computers.
- High staff turnover as junior staff leapfrog positions for higher salaries.
- Higher levels of remuneration which cause relativity problems with other staff groups.

To counteract the staff shortage it is suggested that much more training of present governmental staff be carried out and that a continual flow of trainees into the various centres be maintained.

The private sector also has an obligation to train its own data processing staff. Where possible, maximum use should be made of existing staff and only the few highly technical positions should be staffed from outside the organisation. By using existing staff, this can reduce the cost of obtaining additional people and, in addition, bring to the data processing task some intimate knowledge of the application to be serviced.

"Buying in" of staff from the private sector is counteracted by movement of staff from the public to the private sector and this has the effect of increasing the costs of a small pool of staff to both sectors.

In some situations it may be relevant to use packaged software or make short-term use of the private sector for people to develop systems.

2. *Education and Training*

Initially, computer training was provided by equipment vendors and, while this role is still an accepted responsibility, much wider avenues of training are now necessary.

Universities have made a significant contribution in the development of pure computer-related skills, and many students receive some exposure to the implications and use of computers in degree courses.

Because of their purpose and scope, university computer science courses, emphasising as they do academic influence, do not produce the type of skills which are required in practical business or public sector situations. Some practising computer experts are adamant that university training overemphasises the technicalities of computer science and hardware design for a country with no hardware manufacturing industry.

Other tertiary institutions such as technical institutes provide data processing training on a more practical basis. However, these institutions have been struggling for many years in terms of facilities, relying on the generosity of commercial and public sector installations to provide a minimum exposure to modern data processing methods. Presently, students at technical institutes may use outdated equipment and software, with only very limited access to modern equivalents. "Hands on" practical experience is therefore limited. Technicians involved in other skills at technical institutes should ideally have access to modern design methods using computers, but they often have little or no chance to use the computer as a tool. This can mean that time is wasted learning manual methods which would rarely be used in outside employment.

Some secondary schools provide an introduction to computers with a very limited introduction to programming. Training is restricted, though, by extremely limited facilities.

Investigations and recommendations on data processing educational requirements have frequently been made, but there appears to be an inability—or an unwillingness—by the Department of Education to recognise the importance of computers.

3. *Top Management Involvement and Understanding of Data Processing*

It was emphasised that the most successful installations are those where management, particularly senior management, is deeply involved in important aspects of data processing.

Those organisations that provide good results from data processing invariably have a top management involvement right from the beginning of the acquisition process through to the day-to-day management of the data processing function.

In other fields, staff with practical experience often later move into senior management but this has not tended to happen in data processing. Because technically-orientated data processing staff have not moved on to other management positions, the knowledge they possess has not spread outside the data processing department.

The resulting deficiency in senior management knowledge is characterised by the following:

- Lack of knowledge of how EDP functions.
- Lack of knowledge of EDP capabilities and restrictions.
- Poor communications between EDP departments and management.
- Inadequate management of the day-to-day function of EDP.
- Impractical requests for reports.
- Lack of knowledge of EDP aims and objectives for the organisation.
- Inclination to delegate major EDP decisions.

At least one vendor company has developed a training course for senior management to identify their responsibilities, in management terms, and to provide an awareness of the control mechanisms at their disposal. Where necessary, senior management should take measures to obtain appropriate training.

4. *User Involvement*

> "A part-time or half-hearted approach to development almost invariably gives an unsuccessful system. The people concerned are not only computer staff—they must include first class staff from the department using the system, and those people must be dedicated in both senses—to getting the best possible system for their use."
>
> "Undoubtedly, one of the most glaring deficiencies in the EDP industry is the extremely poor user definition of requirements and the unwillingness of the user departments to become involved in the development of new software programmes."

Probably many systems developed today do not meet the initial expectation of the user department.

5. *Project Control*

The success of a project demands that the full scope is known, the resources are available, and the time is sufficient. With the relationship between these factors understood, management is then in the position to plan the project. Sometimes there is the incorrect assumption that the alteration of one or more of the above factors will not affect the completion date. Commitment and involvement of senior management are key elements of good project control.

6. *Increasing Importance of Software Considerations*

It is widely acknowledged that hardware costs have decreased over recent years. The hardware element seldom represents more than 30

percent of the total costs of operating a data processing department. It is felt that too little emphasis in the acquisition process is placed on:

- Easy-to-use software.
- Cost of implementation.
- Cost of recurring software maintenance.

B. Issues Raised in Two or Three Submissions

1. Additional management training facilities in data processing are required.
2. Establishment of a standard government purchase contract would be inappropriate.
3. There should be more private sector involvement in public sector computing.
4. Removal of the sales tax on equipment should be considered in certain situations.
5. Greater end-user programming is likely to be prevalent in the future.
6. There should be a formalised professional development plan for data processing staff.

1. *Management Training Facilities*

One major area of deficiency in the New Zealand data processing scene is the lack of management training facilities in data processing. Tertiary institutions are devoted to the computer operating and programming areas and offer little real training in the management and control aspects of computing nor of the business systems environment generally.

Overseas management training requirements in data processing are met by institutions such as the Massachusetts Institute of Technology or the Harvard Business School.

The capability to provide for similar courses does not exist in New Zealand at present.

2. *Standard Government Purchase Contracts*

It is corporate policy with some of the vendor companies that a standard corporate contract be required for all EDP installations. It is considered doubtful that any form of standard Government contract would be able to mirror the terms and conditions of the various corporate contracts and, because of this, would be unacceptable to the major EDP companies.

One vendor company considers that use of a standard Government contract is not necessary providing the existing safeguards are enforced.

Another vendor company considers that it would be inappropriate for the Government to establish a standard contract for all projects and for all suppliers.

3. *Private Sector Involvement in Computing Services*

One organisation commented that similar organisations overseas obtain a much larger percentage of their total income from contract services with the public sector. Sometimes this percentage can be as much as 85 percent. The following points relevant to this issue were made:

> "By using the private sector the Government is ensuring the most cost-effective solutions to its problems through the natural forces of the market place. Organisations like ours have to produce results for our

clients within agreed time scales and within agreed budgets otherwise we cease to operate. No such imperatives drive a centralised, Government-operated computing facility."

"By letting contracts to the local private sector the Government is materially assisting in the growth and development of technical and business skills within the computer industry. This is an essential component in the development of the high technology infrastructure necessary for the 1980s."

"If free market forces were allowed to prevail and Government departments were allowed to tender on the open market for projects and/or processing services, then the question of the efficiency or otherwise of Government's own computing resources would not be an issue."

4. *Sales Tax on Equipment*

The sales tax on private sector equipment is a considerable, additional cost burden to bear.

One organisation states that:

"In order to ensure comparison on an equitable basis, either Government computers will have to be subject to the same import duty as the private sector or conversely computers used by bona fide computer services organisations in the private sector should be exempt from the present crippling and counter-productive duty."

Additionally, it is said that the sales tax levied on hardware in the private sector encourages organisations to develop software to an uneconomical point in order to avoid purchasing further hardware, and this disadvantage is not experienced in some areas in the public sector.

Note—Exemptions from sales tax on equipment purchases apply to education institutions (where equipment is utilised for educational purposes), hospital boards, and non-trading Government departments.

5. *Ease of Use of Systems Software in the Future*

Software is being developed which offers new solutions to computer applications and allows economic approaches which previously were not so readily available.

With EDP systems becoming simpler to program, a move towards program development by end-users is foreseen. Arising from this development there is likely to be a growing need for persons with a sound knowledge of data processing capabilities as well as having an understanding of management systems and management decision-making requirements.

6. *Professional Development Plan*

A continuing training and development plan for EDP staff is regarded as essential. It has been shown in recent computer publications that a proper development plan is a key factor in providing stability, particularly with staff in positions which are difficult to replace.

It is considered that a fully co-ordinated professional development plan is most probably a stronger motivation factor than salary levels.

APPENDIX 4

BRIEF GUIDELINES FOR THE MANAGEMENT OF COMPUTERS

This section provides a brief guideline for data processing managers to ensure proper management of computer resources. These guidelines were prepared as a basis for the evaluation of computer installations during the review. Essentially they are a list of points to be covered rather than a detailed description of all action required.

Top management should be aware of the necessity for guidelines such as these to be adopted.

A. New Project Development

For all new applications there should be:

1. *Problem Definition*
   (a) Clear concise description of the problem.
   (b) Adequate coverage of all affected areas.
   (c) Consultation and formal agreement with affected management.

2. *Preliminary Survey of Needs*
   (a) Clear concise description of the existing system.
   (b) Adequate investigation to identify all potential users.
   (c) Full coverage of user needs.

3. *Feasibility Study*
   (a) A proper study conducted including costs and benefits.
   (b) Full consideration of alternatives such as:
      Retain manual system
      Purchase of a package or special design
      Own-design or design by independent software contractor
   (c) Consideration of staff availability, especially design capability.
   (d) An adequate level of review by management including assessment of priority in relation to other demands for EDP resources.

4. *Requirement Specifications*
   (a) Detailed specification of all user requirements in non-technical language.
   (b) Consultation and formal agreement between users and data processing staff on feasibility of requirements.

5. *Design*
   (a) Availability of alternative packages.
   (b) Design specifications prepared based on user specifications.
   (c) Design standards adopted with adequate review procedures.
   (d) Updating of costs and benefits with review by management.
   (e) User acceptance criteria set.

6. *Development*
   (a) Detailed plan of procedures leading to implementation.
   (b) Full project control procedures prepared and adhered to.

(c) Proper monitoring of progress with specified target dates.
(d) Adequate top management involvement and formal authorisation and approval of each major development phase.
(e) Monitoring of costs and benefits with review by management.

7. *Testing*

(a) Full testing to ensure the system is operating according to plan.
(b) Adequate test data provided by the user.
(c) Formal approval of test results by the user.

8. *Conversion*

(a) Detailed conversion procedures.
(b) Adequate coverage of user requirements, e.g. staff training, user instruction manuals, data control instructions.
(c) Formal acceptance by the user in accordance with original criteria.

9. *Monitoring/Post-implementation Review*

(a) Comparison with originally agreed objectives.
(b) Data processing management review of adherence to documentation standards and compliance with normal procedures for testing and/or conversion.
(c) Management consideration of specific user criticism of EDP service and output.
(d) Final review of actual costs and benefits.

B. Hardware Acquisition

For new hardware acquisition or major upgrade of hardware, there should be:

1. *Forward Projection of Workloads*

(a) Forward projection of workloads of existing applications.
(b) Estimation of workloads arising from new applications.
(c) Management consideration of whether projected workloads are acceptable with control to prevent piecemeal growth.

2. *Hardware Requirements*

(a) Clear and concise description of hardware requirements in relation to forward projection of workloads, i.e. hardware necessary to service user requirements.
(b) Compatibility with capabilities of data processing and user staff for operation, maintenance, and development of new projects.
(c) Interdependence between hardware and software, especially any problems of compatibility/conversion and/or software packages under consideration.

3. *Acquisition Decision*

(a) Adequate investigation of alternative means of meeting user requirements, including comparison between use of bureau services and in-house computer.
(b) Detailed study of hardware performance and costs.

4. *Procurement*

(a) Authority levels laid down and followed.
(b) Tendering guidelines set and followed including consideration of:
Management satisfaction with hardware and its service.
Vendor support of hardware and software.
(c) Consideration of legal agreement with the vendor.

5. *Post-acquisition Review*

Review by management of problems encountered, costs, and satisfaction.

C. Computer Operations and Systems Maintenance

There should be:

1. *Organisation*

(a) Formal organisational structure and documented allocation of responsibilities including responsibility to top management.
(b) Division of duties consistent with sound management principles.

2. *Standards*

(a) A formal set of documented standards for:
Systems Development
Programming
Documentation
Operating
(b) A system of management which reviews standards and ensures they are updated.
(c) A formal system of written authorisation for changes to systems and programs.

3. *Quality Control*

A formal means of ensuring that standards are followed and the quality of work maintained. There should be reviews of:
systems development and programming,
documentation,
authorisation of changes to systems and programs.

4. *Data Preparation and Capture*

(a) Formal scheduling and organisation of work to ensure completion of work in accordance with management/user deadlines and priorities.
(b) Review by management of workloads, work peaks, and work output, to ensure efficient use of staff and facilities.

5. *Computer Operations*

(a) Formal scheduling and organisation of work to ensure completion of work in accordance with management/user deadlines and priorities.
(b) Review by management of workloads, work peaks, and work output, to ensure efficient use of staff and computer facilities. This

will involve consideration of the economy of operating hours/shifts, comparing the costs of hardware, staff availability, and user requirements with the available capacity.

(c) Review by management of hardware malfunctions, job failures, and re-running, i.e. assurance of job quality.

(d) For medium and large installations, management action to ensure total systems performance evaluation (also called monitoring or tuning).

(e) Management identification of the applications which are critical in determining the demand for computer resources (e.g. CPU usage, file storage requirements, print workloads), and review of these applications with the view to possible improvements in efficiency or reductions in computer resource use.

(f) Management review of projected workloads to ensure user requirements are properly organised in advance of excess demand situations.

6. *Security*

(a) *Back-up*—Organised and tested contingency back-up computing facilities for critical applications, e.g. payrolls.

(b) *Physical Security*—Management review of physical security over:
Buildings against fire, water damage, unauthorised access.
Computer room for air-conditioning, power supply, unauthorised access.
Files and systems documentation, i.e. off-site storage.
Personnel reliability.

(c) *Data Integrity*—Management review of control over:
Input data.
Access to remote terminals and/or misuse of terminals.
File protection including improper amendment, unauthorised access, and back-up protection against processing errors.
Output data available only to intended users.

7. *Staffing*

(a) Management recruitment policy to ensure a continuing supply of suitable staff taking into account turnover rates.

(b) A properly organised training policy and programme to ensure that EDP staff receive training needed for their tasks.

(c) Management assessment of the quality, skills, and experience of staff.

(d) Time recording of work for individual applications, management control over work, and costing of time for charging to users.

8. *Management of Computer Use*

(a) *Resource Allocation and Priorities:* A formal system of allocation of computer resources to users in accordance with management priorities.

(b) *Accounting/Cost Responsibility by:*

(i) Costing system for recording computer use and charging users (either in cash or budget terms) to ensure that users are made cost responsible for the computer resources (systems development, computer operation and data collection) required for each application.

(ii) Formal budgetary control over total EDP installation costs.

(c) *User Satisfaction by:*

(i) Formal review procedures (e.g. post-implementation review) for management to periodically assess user requirements and the continuing need for processing each application and production of routine reports (i.e. job still needed and reports actually used and useful).

(ii) Where applicable, formal evaluation of the service provided by independent contractors or software packages purchased externally.

APPENDIX 5
EVALUATION OF INSTALLATIONS FORMALLY REVIEWED

During the study over 100 organisations were visited. These are listed in Appendix 2. In most of the organisations, staff in the following positions were interviewed:

Chief executive.
Member of top management responsible for data processing.
Data processing manager.
Data processing operations manager.
Applications development manager.
Systems programmer.
Representative computer users.

In small organisations or those which use a bureau, not all of these positions were applicable.

In addition to the management guidelines in Appendix 4, an evaluation table was developed to provide a consistent means of assessing the larger installations which were formally reviewed. Managers may find this a useful checklist for their own organisation.

A summary of the evaluation of the 38 installations formally reviewed is set out below. The table shows the number of installations within each category. Where "not applicable" is indicated, this is normally for one of the following reasons:

(a) One top management controlling more than one installation.
(b) Developing installations where not all phases have been implemented.

1. TOP MANAGEMENT

1.1 *Planning*—

1. Objectives set by top management.
2. Detailed plan for next 12 months.
3. Strategic planning for 1–5 years.
4. Alternatives considered.

	Not Applicable	Non-existent	Very weak	Poor	Average	Above average	Outstanding
Central government	7	1	1	3	–	2	–
Local authorities	–	–	4	4	7	4	1
Statutory boards and corporations ...	–	–	–	2	–	2	–
OVERALL	7	1	5	9	7	8	1

1.2 *Co-ordinated Data Processing Policy*—

1. Organisation-wide and integrated.
2. All potential application areas incorporated.

Central government	7	2	1	2	2	–	–
Local authorities	–	–	5	5	7	2	1
Statutory boards and corporations ...	–	–	–	1	1	2	–
OVERALL	7	2	6	8	10	4	1

1.3 *Resource Allocation*—

1. All requirements identified.
2. In accordance with plan.
3. Positive decision on use of existing as well as new resources.
4. Monitoring of actual usage.

Central government	7	–	2	4	1	–	–
Local authorities	–	–	3	7	5	4	1
Statutory boards and corporations ...	–	–	–	1	1	2	–
OVERALL	7	–	5	12	7	6	1

1.4 *Organisational Structure—*

1. Organisational structure and responsibilities.
2. Appropriate positioning of EDP section.
3. Direct access to top management.
4. Clearly laid down responsibilities and duties.
5. Specified relationship with users.

	Not Applicable	Non-existent	Very weak	Poor	Average	Above average	Outstanding
Central government	7	–	1	2	1	2	1
Local authorities	–	–	4	4	4	6	2
Statutory boards and corporations ...	–	–	–	1	2	1	–
OVERALL	7	–	5	7	7	9	3

1.5 *Top Management Involvement at Crucial Stages of Project Development—*

1. Specification of requirements
2. Feasibility study.
3. Software design.
4. Hardware acquisition.
5. Implementation control.
6. Post-implementation review.

Central government	7	1	2	–	1	3	–
Local authorities	4	–	2	3	7	4	–
Statutory boards and corporations ...	–	–	–	–	4	–	–
OVERALL	11	1	4	3	12	7	–

1.6 *Staffing Policy—*

1. Recruitment.
2. Training.
3. Regular assessment of individuals.

Central government	7	–	–	2	2	3	–
Local authorities	–	–	2	6	7	5	–
Statutory boards and corporations ...	–	–	–	–	4	–	–
OVERALL	7	–	2	8	13	8	–

2. ACQUISITION POLICY

2.1 *Hardware—*

1. Estimation of future demands.
2. Adequate assessment of resource requirements.
3. Consideration of alternatives e.g., bureau, in-house.

Central government	7	–	3	1	1	2	–
Local authorities	–	–	3	5	2	9	1
Statutory boards and corporations ...	–	–	–	2	1	1	–
OVERALL	7	–	6	8	4	12	1

2.2 *Software—*

1. Requirements defined.
2. Own-design and purchase considered.

Central government	5	–	1	2	–	5	1
Local authorities	–	–	1	4	7	6	2
Statutory boards and corporations ...	–	–	–	1	2	1	–
OVERALL	5	–	2	7	9	12	3

	Not Applicable	Non-existent	Very weak	Poor	Average	Above average	Outstanding
2.3 *Contracts*—							
1. Hardware/software performance criteria.							
2. Cost effectiveness of maintenance contracts.							
Central government	8	–	2	–	2	2	–
Local authorities	–	–	1	3	9	6	1
Statutory boards and corporations ...	–	–	–	–	4	–	–
OVERALL	8	–	3	3	15	8	1
2.4 *Consultants*—							
1. Employment reasoning.							
2. Continuing cost effectiveness.							
Central government	9	–	2	–	1	2	–
Local authorities	13	–	3	3	–	1	–
Statutory boards and corporations ...	2	–	–	–	1	1	–
OVERALL	24	–	5	3	2	4	–
3. DATA PROCESSING MANAGEMENT							
3.1 *Resource Allocation*—							
1. Within top management policy.							
2. Adequate consideration of all user demands.							
3. Monitoring of resource usage.							
Central government	1	–	3	2	5	3	–
Local authorities	1	–	–	4	9	5	1
Statutory boards and corporations ...	–	–	–	–	4	–	–
OVERALL	2	–	3	6	18	8	1
3.2 *Routine Installation Management*—							
1. Management structure for: —applications development —systems software support —operations.							
2. Staffing needs.							
Central government	1	–	1	1	4	7	–
Local authorities	–	–	1	1	8	10	–
Statutory boards and corporations ...	–	–	–	–	4	–	–
OVERALL	1	–	2	2	16	17	–
3.3 *Operations Control*—							
1. Priorities.							
2. Job instructions.							
3. Application of efficiency.							
Central government	1	–	1	2	4	3	3
Local authorities	–	–	3	–	6	10	1
Statutory boards and corporations ...	–	–	1	–	3	–	–
OVERALL	1	–	5	2	13	13	4
3.4 *Application Software Performance*—							
1. Individual application review.							
2. Review of other software including packages.							
Central government	2	1	2	4	–	3	2
Local authorities	1	3	3	3	6	4	–
Statutory boards and corporations ...	–	–	–	2	1	1	–
OVERALL	3	4	5	9	7	8	2

3.5 *Hardware Maintenance*—

Regular, reliable service.

	Not Applicable	Non-existent	Very weak	Poor	Average	Above average	Outstanding
Central government	2	–	–	1	8	2	1
Local authorities	1	–	2	2	10	4	1
Statutory boards and corporations ...	–	–	–	–	3	1	–
OVERALL	3	–	2	3	21	7	2

3.6 *Total Systems Performance*—

Measurement:
—hardware
—systems software.

Central government	2	2	3	1	3	2	1
Local authorities	3	2	2	4	2	5	2
Statutory boards and corporations ...	–	–	–	1	3	–	–
OVERALL	5	4	5	6	8	7	3

3.7 *Standards*—

1. Formalised.
2. Adequacy of coverage.
—application, development, and programming
—documentation.

Central government	1	–	1	3	7	2	–
Local authorities	1	–	1	6	6	5	1
Statutory boards and corporations ...	–	–	–	1	1	2	–
OVERALL	2	–	2	10	14	9	1

3.8 *Physical Security*—

1. Access.
2. File security.
3. Documentation.

Central government	2	–	–	2	1	5	4
Local authorities	2	–	–	7	8	2	1
Statutory boards and corporations ...	–	–	–	1	1	2	–
OVERALL	4	–	–	10	10	9	5

4. APPLICATION DEVELOPMENT AND EFFECTIVENESS

4.1 *Project Control*—

1. Specification of requirements.
2. Feasibility study.
3. Software design.
4. Implementation control.
5. Post-implementation review.

Central government	2	–	5	2	2	2	1
Local authorities	2	–	1	3	8	5	1
Statutory boards and corporations ...	–	–	–	2	1	1	–
OVERALL	4	–	6	7	11	8	2

	Not Applicable	Non-existent	Very weak	Poor	Average	Above average	Outstanding
4.2 *User Involvement*—							
1. New projects.							
2. Acceptance testing.							
3. Formal liaison with EDP section.							
Central government	3	–	1	2	5	2	1
Local authorities	2	–	1	5	6	5	1
Statutory boards and corporations ...	–	–	–	3	–	1	–
OVERALL	5	–	2	10	11	8	2
4.3 *Application Review*—							
1. User involvement in post-implementation review.							
2. Periodic review of application effectiveness.							
Central government	3	1	2	4	1	3	–
Local authorities	5	–	4	4	4	2	1
Statutory boards and corporations ...	–	–	–	3	1	–	–
OVERALL	8	1	6	11	6	5	1

APPENDIX 6

STATISTICS FROM THE SURVEY OF COMPUTING IN THE PUBLIC SECTOR

This survey aimed to gather basic factual information on the use of computers throughout the public sector by the use of questionnaires. Questions covered the number and type of computers in use, bureaux used, the types of applications, the value of the computers, the annual costs for 1978–79 of computing, staffing, and management views. Not all this information is suitable for publication but a summary of the most important is included here.

In total, 521 organisations were surveyed of which 341 (65 percent) used computers. These 341 organisations used 70 different bureaux (with 314 separate arrangements) and 373 computers. The estimated value of the computers within the public sector is $111 million and the annual expenditure on computing in 1978–79 was $58.5 million. There were 2828 people employed in data-processing for the public sector.

Details are given in the tables which follow.

SUMMARY OF QUESTIONNAIRES

	Computer Users			*Non-Users*	*Total*
	Bureau Only	*Own Computer Only*	*Bureau and Own Computer*		
Central government	13	4	14	2	33
Local government—					
Territorial—					
Cities	8	13	6	–	27
Boroughs	28	16	4	52	100
Counties	16	26	6	43	91
Town councils	–	–	–	3	3
District councils	–	4	2	3	9
	52	59	18	101	230
Education—					
Tertiary institutions	3	9	9	7	28
Other institutions	12	2	3	16	33
Electric power boards	7	19	11	1	38
Harbour boards	3	8	2	2	15
Hospital boards	9	1	5	14	29
Other local authorities	21	11	4	24	60
Total local government ...	107	109	52	165	433
Statutory boards/corporations—					
Statutory boards	23	4	5	13	45
Corporations and companies ...	1	3	6	–	10
Total boards/corporations ...	24	7	11	13	55
Overall total	144	120	77	180	521

NOTE—The survey covered all territorial local authorities, electric power boards, harbour boards, hospital boards, and licensing trusts. Questionnaires were not sent to other organisations thought not to be using computers, e.g., secondary schools.

COMPUTERS IN THE PUBLIC SECTOR AS AT 30 SEPTEMBER 1979

	Number of Computers			
	Small	*Medium/ Large*	*Total*	*Estimated Value*
				$(m)
Central government	67	23	90	65.8
Local government—				
Territorial (cities, etc.)	72	14	86	7.8
Education—				
Universities	59	9	68	5.0
Other institutions	18	1	19	1.9
Electric power boards	28	6	34	3.7
Harbour boards	10	4	14	1.7
Hospital boards	11	1	12	0.9
Other local authorities	15	1	16	0.8
Total local authorities	213	36	249	21.8
Statutory boards/corporations—				
Statutory boards	9	3	12	3.4
Corporations and companies	12	10	22	20.4
Total boards/corporations	21	13	34	23.8
Overall total	301	72	373	111.4

NOTES—1. Excludes intelligent terminals which do not normally operate independently. This mainly affects central government, e.g., one installation has 48 intelligent terminals.

2. Omits some small computers in the education area.

PUBLIC SECTOR USE OF BUREAUX OR OTHER ORGANISATIONS' COMPUTERS AS AT 30 SEPTEMBER 1979

Bureau Users	*Organisation Providing Bureau Service* — *Number of Arrangements*						
	Central Government	*Territorial Authorities*	*Universities*	*Statutory Boards*	*Commercial Bureaux*	*Chartered Accountants*	*Total*
Central government...	44	–	7	1	1	–	53
Local government—							
Territorial	1	24	1	–	52	–	78
Education	16	–	6	1	23	1	47
Electric power boards	–	–	–	–	24	–	24
Harbour boards	–	1	1	–	3	–	5
Hospital boards	14	1	2	1	3	–	21
Other local authorities	5	7	2	–	8	5	27
Total local government	36	33	12	2	113	6	202
Statutory boards/corporations—							
Statutory boards	5	1	8	6	16	3	39
Corporations and companies	3	–	2	–	13	2	20
Total statutory boards/corporations	8	1	10	6	29	5	59
Overall total	88	34	29	9	143	11	314
Percentage of total	28	11	9	3	46	3	100

ANNUAL COST OF COMPUTING IN THE PUBLIC SECTOR 1978–79

	Central Government	*Local Government*	*Statutory Boards/ Corporations*	*Total*
	$m	$m	$m	$m
Data processing staff	14.0	6.0	5.0	25.0
Materials, supplies	2.5	1.2	0.7	4.4
Maintenance of equipment ...	4.5	1.5	0.5	6.5
Hire of equipment	1.3	1.2	1.4	3.9
Outside services, bureaux, consultants	3.5	2.4	1.4	7.3
Other costs	9.9	0.8	0.7	11.4
Total	35.7	13.1	9.7	58.5
Percentage of total	61	22	17	100

NOTES—

1. These figures are based on information supplied on the questionnaires which has not been confirmed.
2. The costs are probably understated as some returns did not show costs, especially for small computers.
3. Data processing staff costs exclude personnel who use computers but whose prime task is other than data processing, e.g., scientists, engineers, academic staff, clerical staff using terminals.
4. "Other costs" includes a varied treatment of equipment purchases, alterations to buildings, and in some cases depreciation of equipment.
5. For central government, inter-organisational charging for services has been eliminated. This has not been possible for local government and statutory boards/corporations so that a small element of double counting remains.

PUBLIC SECTOR COMPUTER APPLICATIONS ANALYSED BY TYPE AND COST

	Type of Application					
	Accounting (Percentage)	*Administrative (Percentage)*	*Planning (Percentage)*	*Scientific/ Engineering (Percentage)*	*Other (Percentage)*	*Total (Percentage)*
Central government	28	11	6	18	37	100
Local government—						
Territorial	91	5	1	1	2	100
Education	19	21	9	36	15	100
Electric power boards	95	2	1	1	1	100
Harbour boards	83	12	–	4	1	100
Hospital boards	32	14	3	17	34	100
Catchment boards	67	12	–	21	–	100
Licensing trusts	99	1	–	–	–	100
Other local authorities	26	4	4	1	65	100
Statutory boards/corporations—						
Statutory boards	44	39	6	10	1	100
Corporations and companies	50	11	13	11	15	100
Overall	58	11	5	12	14	100

DATA PROCESSING STAFF IN THE PUBLIC SECTOR AS AT 30 SEPTEMBER 1979

	Staff Numbers				*Average Experience (Trained Staff) Years*	*Staff Turnover*	
	Trained Staff	*Trainees*	*Vacant*	*Total Positions*		*Last Year Percent*	*2 Years Ago Percent*
Data processing management	200	8	8	216	10.0	34	26
Applications development—							
Planner/analysts ...	179	7	56	242	6.0	53	25
Analyst/programmers	176	11	39	226	5.6	47	32
Programmers ...	196	50	34	280	3.7	64	56
Systems programmers ...	113	11	38	162	4.7	8	13
Operations—							
Operations supervisors	129	11	22	162	5.4	33	8
Computer operators ...	400	116	43	559	2.8	83	74
Data control ...	176	26	5	207	4.8	57	60
Data preparation supervisors	128	5	–	133	7.2	16	13
Data preparation operators	781	105	30	916	4.8	65	81
Total	2 478	350	275	3 103			
Percentage of total ...	80	11	9	100			

DISTRIBUTION OF PUBLIC SECTOR DATA PROCESSING STAFF POSITIONS AS AT 30 SEPTEMBER 1979

		Percentage
Central government...		58
Local government—		
Territorial	10	
Other local authorities	17	
	—	27
Statutory boards/corporations—		
Statutory boards	5	
Corporations/companies	10	
	—	15
		100

ANALYSIS OF VACANT PUBLIC SECTOR DATA PROCESSING STAFF POSITIONS AS AT 30 SEPTEMBER 1979

	Proportion of Positions Vacant (Percentage)
Management staff	3.7
Applications development	18.4
Planner/analysts	23.1
Analyst/programmers	17.3
Programmers	12.1
Systems programmers	23.5
Operations	7.5
Operations supervisors	13.6
Computer operators	7.7
Data control	2.4
Data preparation	2.9
Supervisors	–
Operators	3.3
OVERALL	9.0

SOURCES OF RECRUITMENT OF PUBLIC SECTOR DATA PROCESSING STAFF

	Proportions of Staff from Each Source			
	Data Processing Management Staff (Percentage)	*Applications Development Staff (Percentage)*	*Operations Staff (Percentage)*	*Total (Percentage)*
Within the organisation (i.e. outside EDP section)	57.8	27.4	33.4	33.6
Technical institute students ...	–	6.5	0.9	2.6
University students	1.4	13.2	1.2	5.0
Secondary school	2.8	10.8	29.3	21.2
Employment within New Zealand—				
Public sector	16.2	11.0	11.6	11.8
Private sector	14.2	23.9	21.8	21.9
Directly recruited from overseas ...	7.6	7.2	1.8	3.9
	100.0	100.0	100.0	100.0

NOTE—Based on those questionnaires where information was provided.

FORMAL QUALIFICATIONS HELD BY PUBLIC SECTOR DATA PROCESSING STAFF

	Proportions of Staff with Each Qualification			
	Data Processing Management Staff (Percentage)	*Applications Development Staff (Percentage)*	*Operations Staff (Percentage)*	*Total (Percentage)*
University degree—EDP orientated—				
completed	6.4	14.2	2.2	6.7
partly completed	4.0	2.3	0.7	1.6
University degree—other subjects—				
completed	22.8	18.4	1.2	9.3
partly completed	3.2	5.5	1.5	3.0
Technical certificate—EDP orientated—				
completed	5.0	10.4	0.3	4.3
partly completed	0.8	3.0	0.8	1.6
Technical certificate—other subjects—				
completed	0.8	0.7	0.2	0.4
partly completed	6.4	1.0	0.3	1.2
Other professional qualifications (e.g., A.C.A.)	4.6	1.3	1.8	1.9
University entrance	17.8	24.0	30.7	27.0
School certificate	13.7	11.7	39.4	27.3
Other	14.5	7.5	20.9	15.7
	100.0	100.0	100.0	100.0

NOTE—Based on those questionnaires where information was provided.

MANAGEMENT COMMENTS ON QUESTIONNAIRES

	Data Processing Management (Percentage)	*Top Management (Percentage)*
Strengths of data processing—		
Good back-up	4	3
Quality of staff	15	17
Availability of information	17	16
Reliability of information	11	10
Easily understood systems	5	4
Flexibility of applications	12	10
Quantity of information	6	6
Uniformity of speed	15	16
Good control	8	5
Other	15	14
Weaknesses of data processing—		
Poor back-up	6	6
Quality of staff	15	14
Unavailability of information	5	4
Unreliability of information	2	2
Systems difficult to understand	–	1
Inflexible applications	5	7
Limited input capability	5	6
Limited storage	5	5
Reliance on others	10	10
Others	24	22
Opportunities for improvement—		
New programs	18	16
Better availability of information	6	5
Improved awareness	7	7
Better use of education	3	5
Direct access equipment	17	13
Other	23	26
Risks—		
Staff inexperience	21	20
No back-up	12	12
Site poor	11	7
Security	7	7
Programmers far from site	5	5
Other	23	25
Unforeseen benefits—		
Faster processing	...	6
Information beyond normal	...	8
Staff economies	...	4
Rapid information retrieval	...	4
Unforeseen disadvantages—		
Too rigid	...	5
Staffing problems	...	7
High degree of accuracy necessary	...	4
Time involved in software development	...	5

APPENDIX 7

LIST OF OBSERVATIONS, ISSUES, AND RECOMMENDATIONS

PART I—OBSERVATIONS COMMON TO ALL PUBLIC SECTOR ORGANISATIONS

Management

Observations

1. Senior management are generally not giving the commitment to computing needed to ensure it is a success.
2. Customary lines of communication within the organisation have often not been established. The EDP section is often treated as a special case and may not have ready access to the top management team.
3. Planning for data processing functions, if prepared, is normally not an integral part of an overall corporate plan.
4. Decisions have been made by both top management and elected representatives without adequate consideration of the likely effect on data processing.
5. Decisions to purchase or lease computers have been made without full awareness of total costs.
6. Existing systems have been computerised without recognition of the potential of alternatives or the wider ranging implications for related systems.

Recommendations

1. **Managers should be encouraged to understand the use and management of computers as this is becoming an essential element of their responsibilities. The data processing element of existing management training courses should be increased.**
2. **Data processing managers should be given additional exposure to general management problems so that they can identify with the corporate image and goals.**
3. **The EDP function should be separated from operating sections and report to the member of top management responsible for management services functions for the whole organisation.**
4. **Management should develop both strategic (3–5 year) and short-term (1–2 year) plans for computer developments with clear identification of priorities.**
5. **Before decisions are made, elected representatives should ensure that they are adequately advised of the likely impact on data processing.**
6. **Decisions to introduce computing or to develop major projects should be based on careful study of the full costs of the system including the software and recurring costs and the availability of suitable skilled staff.**
7. **Management should ensure that the development of systems includes the consideration of a wide range of options and is not constrained by existing systems or organisational tradition.**

Personnel and Training

Observations

7. There have been persistent problems of vacant positions, high staff turnover, and the inability to readily recruit trained staff. Though the problems have been recognised for some time, the situation has tended to be accepted rather than action being taken to alleviate the difficulty.
8. The shortages and high turnover of data processing staff have consequences of lower levels of experience and faster promotion than desirable. This needs to be compensated for by more emphasis on education and training.
9. As a new and rapidly changing technology, data processing has yet to develop into a recognised profession with formal standards for entry and a minimum level of competence. This leaves employers without readily ascertainable measures of knowledge and skill for staff they recruit.

Recommendations

8. **The management of individual organisations should seek to alleviate problems of data processing staff shortages and high turnover by:**
   (a) Increasing recruitment from within the organisation.
   (b) Providing a well organised work environment, reasonably challenging work, professional development, and well defined alternative career paths.
9. **Recruitment from overseas should be restricted to personnel with select skills and should not be carried out at the expense of staff within New Zealand. Overseas training of New Zealand data processing staff should be considered.**
10. **The review of university courses under the auspices of the University Grants Committee should encourage the development of university data processing courses which are more closely aligned to the long-term needs of New Zealand, for example, analysis and design, data base, data communications.**
11. **An industry training board for data processing should be established under the Vocational Training Council. This board should encourage better training, and co-ordinate courses in data processing for both the public and private sectors. The need for a comprehensive policy for educational computing and computer studies syllabuses is covered in the section on computing in educational institutions. The data processing industry board would need to liaise closely with the Department of Education in the development of computer studies syllabuses.**
12. **Data processing managers of larger computer centres should ensure that co-ordinated professional development programmes are devised for their staff. Such programmes should include provision for data processing managers, project managers, and graduate recruits, as these groups have not received much training in the past.**
13. **The New Zealand Computer Society should be encouraged to continue its efforts towards status as a full professional body setting entry and registration standards and monitoring tertiary education courses.**

Social Implications of Computing

Observation

10. There is little evidence, to date, that computing has affected the overall level of employment in the public sector. The most significant changes due to computing have been in the type of skills required.

Recommendations

14. Throughout the public sector and especially in central government the effects of computer systems should be evaluated from a social as well as a technical and economic viewpoint. This will require cost/benefit studies to include the social implications of a project.

15. The Government should undertake research to determine the probable future effect of new technology on the levels of employment and the job skills of staff.

16. Retraining of staff affected by data processing systems should continue to have a high priority to minimise the effects of job displacement.

Development of Computer Applications

Observation

11. Many public sector organisations do not follow a logical and comprehensive set of procedures when developing computer applications. Under such circumstances the possibility of not achieving the original system aims and objectives is increased.

Recommendation

17. When developing a computer system it is important for management to ensure:

(a) A project manager is made responsible for the planning and control of the project.

(b) The problem definition is documented and agreed, to provide an objective for the project.

(c) Potential users define their requirements in ordinary language. Management should review the completeness and feasibility of these requirements.

(d) The project has a detailed cost/benefit study. This should be reviewed at critical stages in development.

(e) Consideration has been given to the alternative of obtaining similar or packaged systems unless management is satisfied that it is desirable to develop a system using resources available within the organisation.

(f) The necessary investigations are conducted to determine the size and complexity of projects. In some situations this may entail obtaining independent technical advice.

(g) Design, programming, documentation, and other procedural standards are formally recorded for all installations.

(h) Users are fully involved in testing, that is, supplying test data and formally approving the results.

Acquisition of Hardware and Software

Observations

12. Computer acquisition evaluation normally concentrates on hardware rather than the total cost. Insufficient consideration is given to the range of available alternatives to the purchase of hardware and development of own-design software. Inadequate effort is devoted to defining current and future resource requirements for hardware, software, and staff.
13. Pioneering new computer equipment and systems software is difficult and often carries a high degree of risk.
14. Computer hardware purchase contracts often omit vital clauses relating to maintenance and the setting of performance criteria.

Recommendation

18. When making acquisition decisions, management should:
- **(a) Establish total computer resource requirements to meet both existing and future needs.**
- **(b) Consider the full range of processing options available including facilities within the organisation, bureau use, and sharing facilities with other organisations.**
- **(c) Prior to upgrading or replacing an existing computer, consider all other possibilities such as tuning existing hardware, running extra shifts, or using dedicated minicomputers for certain tasks.**
- **(d) Prior to the development of own-design software, consider the full range of options including the use of standardised packages and developed software from other organisations.**
- **(e) Consider the interdependence between hardware and software.**
- **(f) State requirements in a non-technical manner and request vendors to comment. This helps to ensure that a wider range of possibilities is considered.**
- **(g) Consider relevant alternatives. Ensure options have been listed, for example second-hand or plug-compatible equipment, other third party equipment, mainframe expansion versus dedicated minicomputer, use of bureau.**
- **(h) Ensure costings are complete. All maintenance, other running costs, additional staff, and conversion costs should be included.**
- **(i) Ensure tender clearly states requirements. The technical specification should include formal evaluation criteria.**
- **(j) Evaluate responses using a consistent basis and select the most suitable, cost-effective tender.**
- **(k) Ensure equipment performance criteria, maintenance agreement, and delivery dates are included in the purchase contract.**

Systems Performance Evaluation

Observation

15. Management has not ensured that computer resources are used efficiently through requiring properly conducted reviews of hardware, systems software, and major applications. Systems performance

evaluation techniques are not widely employed in the public sector and, even where employed, are normally not on a continuing basis.

Recommendations

19. Before commencing development of computer applications, estimates should be made of the likely requirement for hardware resources. For major applications these estimates should be continuously updated during the development phase.

20. Applications programs which make significant use of computer resources should have their efficiency reviewed on a continuing systematic basis.

21. For all medium to large computers, management should ensure that systems performance is monitored on a recurring basis. For large installations this will require specialised staff who will need access to suitable monitors.

Data Communications and Networks

Observations

16. There are a large number of communication protocols in use reflecting differing views of manufacturers and an initial lack of internationally agreed standards.
17. The Post Office has been criticised by some data communication users for introducing new services with little warning or consultation, for delays in the provision of lines, and for failing to recognise and remedy customers' line problems. This criticism may not be well founded.
18. There is concern that the Post Office will increase tariffs for existing services substantially to obtain quick returns from new facilities. This concern seems groundless.

Recommendations

22. The Post Office and Government agencies should be committed to a long-term objective of rationalising protocols. This objective should be a major evaluation factor during the purchase of all related equipment.

23. Data communication users should actively seek contact and ongoing liaison with the Post Office to ensure co-ordination in the provision of data circuits and the introduction of new services.

Co-operation Between Public Sector Organisations, Data Interchange, and Security

Observations

19. Opportunities exist for significant cost savings and other benefits through co-operation between public sector organisations for the joint use of computer resources, joint development of applications, and exchange of data.
20. There is a need for public sector guidelines on data integrity and privacy.

Recommendations

24. Co-operation between public sector organisations through the joint use of computer facilities, the joint development of systems, and sharing of computer-recorded information should be encouraged. Any proposal which would duplicate facilities should be investigated thoroughly.

25. Standards for data integrity should be developed. These should be prepared in the local government area by the recommended advisory group (see Part II, Recommendation 55) and in central government by the State Services Commission.

26. The Government should encourage the development of privacy standards and incorporate these in legislation.

Private Sector Services

Observation

21. The success of projects where private sector services have been employed has varied and in some instances the service has been unsatisfactory.

Recommendations

27. When using private sector data processing consultants, management should ensure the firm employed has the appropriate skills and experience for the assignment.

28. When public sector organisations employ contract services, management should ensure they are employed on tasks appropriate to their skills and that progress and productivity is monitored.

29. Where private sector contractors undertake complete data processing projects, management should clearly define requirements and responsibility, and closely monitor progress.

30. Arrangements for bureau services should be incorporated into a formal contract which covers levels of service, standards of documentation, and ownership of applications.

PART II—ISSUES SPECIFIC TO EACH CLASS OF PUBLIC SECTOR ORGANISATION

Computing in Central Government

Main Issues

Issues concerning central government computing in general:

1. The method of selecting new data processing projects, by its very nature, can result in resource allocation decisions which do not necessarily lead to the most effective means of achieving the Government's aims.
2. The Computer Services Division of the State Services Commission is seen as having the conflicting roles of:
   (a) Advising departments on the data processing implications of policy and administration.
   (b) Advising the Government, the Treasury, and departments on the technical feasibility of projects, evaluating the justification

provided by departments, and providing limited planning assistance.

(c) Providing the operational data processing services.

This means that operational considerations may unreasonably dominate the evaluation. Departments do not see that advice given to the Treasury is objective.

3. Current Government computing relies on a few large centres. While the policy of centralisation was common some years ago, this may no longer be the best solution in all cases due to the overheads of large machines and changes in the relative cost structure. Little effective back-up exists to ensure the continued operation of essential applications in the event of local problems or disasters.
4. There is no approved co-ordinated long-term plan for central government computing. This is an essential prerequisite for the proper and cost effective use of computers.
5. Some large data processing projects have had problems resulting in budget overruns and performance well below expected standards. One of the major problems has been poor project management.

Issues concerning the Computer Services Division of the State Services Commission:

6. The quality of service to user departments provided by the different computer centres of the Computer Services Division is uneven. Many user departments have expressed dissatisfaction.
7. The method of charging for computer services to individual user departments does not ensure departments are encouraged to use the available computing resources in the most economical manner.

Recommendations

1. **The system for consideration of new computer projects should be altered so that computer proposals are considered along with other departmental new policy proposals.**
2. **Independently of Recommendation 1, the following changes need to be adopted:**
   (a) **Procurement procedures should be scaled to reflect the amount of resources involved. Purchase approvals required to be given by the State Services Commission should be given at the lowest practical level. All departments should receive appropriate financial delegations for expenditure on low value items. Departments making specialist use of computers should receive wider delegations.**
   (b) **A subset of new policy criteria should be devised for EDP projects. These should more closely reflect the role of computers as a service function.**
   (c) **Approval procedures should be streamlined to avoid double presentation to Cabinet committees of all but the very large projects.**
3. **The EDP equipment programme developed by the State Services Commission should be refined and submitted for decision by ministers to ensure a planned programme of replacements.**
4. **Active support should be given to managers to make better use of funds by substitution of computer projects for other new policies or existing expenditure.**

5. Centrally prescribed standards for cost/benefit studies on computing projects should be developed and all proposals submitted to ministers supported by such studies.
6. Departments should be required to conduct formal post-implementation reviews measuring actual costs and the extent to which anticipated benefits have in fact been realised. These reports should be subjected to confirmation by the EDP audit group. For major projects these reports should be sent to the State Services Commission, the Treasury, and ministers.
7. A more comprehensive consulting service for data processing needs to be provided to management in departments. This should be supplied by full-time officers within departments, supported by data processing advisory officers from a restructured Management Services Division of the State Services Commission. The advisory officers should perform both the advisory role and the initial technical feasibility study of new computer projects. To ensure advisory officers can perform these tasks properly, they should not be burdened with any control functions. Officers engaged in the advisory and technical evaluation tasks should be interchangeable with systems development staff. Care also needs to be taken that these officers keep up to date with new technological developments.
8. Both the State Services Commission and the Treasury have a role in advising the Government on EDP projects. The SSC responsibility should be to rank projects according to their potential to improve administrative efficiency within departments. The Treasury should comment on the broad financial and economic implications for central government. Both agencies need to ensure they have the technical capability to evaluate computer projects without reliance on advice from the operational area.
9. There are several alternative forms of organisation for data processing operations and systems development provided centrally to user departments. These are:
   (a) A separate operating division within the State Services Commission.
   (b) A separate agency.
   (c) A Government services department combining data processing operations with other central service functions.

   Whatever form of organisation is chosen by the Government, it is important that the control function be separated from the operations and the advisory role.
10. Departments should be given more flexibility in using the private sector as an alternative to the central government computer centres, where the private sector has specialist expertise and is cheaper. Such an option should be available only after consultation with the restructured Management Services Division of the State Services Commission. The division should ensure adequate provision is made for long-term support of the applications, if a private sector alternative is chosen.
11. The philosophy for central government computing must be regularly reviewed to ensure that the number, size, and location

of computer installations is optimum with regard to the changing relative cost structure and current technology. This should be a task for the new inter-departmental advisory committee on EDP which should have a wider membership.

12. A policy should be developed to ensure tasks are implemented on the appropriate sized machine rather than being automatically allocated to a centre. Where it is considered appropriate that a task be undertaken at one of the established centres, CSD should ensure the task is allocated to the most suitable rather than the most convenient centre.
13. Future procurement should seek to standardise on a limited variety of large computers irrespective of manufacturer to reduce problems of skilled staff and support. Pioneering equipment unproven world-wide should be avoided and equipment unproven in New Zealand should be carefully evaluated.
14. The number of communications protocols should be reduced, leading to higher use of dedicated communications lines and fewer terminal types.
15. Improved back-up for large computer installations should be sought through greater standardisation of machines and the location of more centres at different sites throughout the country. Formal contingency plans should be maintained on a recurring basis to ensure continued operation of systems in the event of local problems or disasters.
16. Spare mainframe capacity should not be wasted but be made available for non-critical tasks at incremental cost to Government agencies and at a fair market price to other users.
17. Comprehensive long-term plans for both systems development and computer equipment should be developed within departments, co-ordinated by the State Services Commission, and incorporated into a rolling 5-year programme. The existing State Services Commission computer equipment programme should form the basis for such a programme, supplemented by departmental requirements. This programme should be approved by both top officials and ministers in a manner similar to the Capital Works Programme.
18. The State Services Commission should be responsible for co-ordinating procurement of all computer hardware unless it is an integral part of other equipment. This co-ordination should be restricted to issuing guidelines for procurement procedures, organising offset arrangements, and negotiating bulk purchase contracts. Departments should then be able to purchase equipment within these guidelines with the minimum of administrative overhead, especially for low-value items under bulk purchase contracts.
19. Staff involved in negotiation of computer purchase arrangements should be specially employed for this work, and trained to a level appropriate to the value of purchases involved.
20. Standard terms and conditions, including performance criteria and maintenance conditions, should be developed for inclusion in all Government computer tender specifications and later incorporated in contracts.
21. Ministers, when contemplating the early introduction of policies which require the development of new systems or

major changes to existing systems, should ensure that they are fully aware of all the data processing and cost implications.

22. It is essential that no new projects be commenced within central government without the adoption by all levels of management of a project control methodology such as the one recently acquired and introduced by the State Services Commission.

23. No project control methodology will work unless the right type of officer is appointed and trained as project manager. The State Services Commission should ensure that, before any project is commenced, a suitable and highly skilled project manager is appointed.

24. Comprehensive standards set by CSD management for all computer centres must be developed. These should cover the following key areas: user liaison, levels of service to clients, charging policy, documentation, development of applications, maintenance, reliability, and timeliness of production. These standards must become the basis for a formal contractual relationship between CSD and users, and to this extent the experiments already carried out in this area by the division are to be encouraged. A policy should be set which will ensure that each centre is appropriately staffed for the number of clients it serves, so it can provide the level of service required by its contracts.

25. A specialist team should be established with responsibility for systems performance evaluation at CSD centres. This team should be equipped with a hardware monitor and visit each centre in turn, reporting to CSD management. Frequently-run application programs should receive regular efficiency reviews.

26. The Director of EDP Audit should perform a management-type internal audit function, carrying out an independent review of all computer policies in central government, and should report directly to the member of the State Services Commission responsible for EDP.

27. Irrespective of the future organisational arrangements for computing in central government, the CSD computer centres should operate on the following financial basis to improve management performance in the centres and user departments and to provide greater accountability for centre performance:
    (a) The computer centres should be removed from the normal Vote accounting system and operate on the basis of a revolving fund in accordance with the following principles:
        (i) Full recovery of all application development, application maintenance, hardware, and operations costs (including amortisation of equipment and interest on capital).
        (ii) Cash thus generated to be retained in the fund to meet costs of operation and capital expenditure without Parliamentary appropriation (see below).
        (iii) Parliamentary appropriations for computer operations to cover costs borne by departments and any additional finance for the revolving fund where computing is to be expanded.
    (b) Agreed financial objectives for CSD should be set by the Government. Some possible objectives are:
        (i) Break-even after all costs.

(ii) Provide an agreed proportion of capital expenditure from a cash surplus generated from annual operations.

(iii) Provide an agreed rate of return on capital.

(c) Annual accrual-based accounts should be prepared, audited, and published in a report to Parliament.

(d) Regular accrual management accounts should be prepared and furnished to centre managers, comparing actual performance with budget.

(e) Control by ministers and control agencies over the level and nature of computing services should be exercised by:

(i) Selecting new computer projects to be implemented for user departments.

(ii) Setting the level of funding for computer expenditure by user departments.

(iii) Requiring user departments to regularly review the efficiency and effectiveness of current data processing operations.

(iv) Approving capital equipment enhancements, replacements, or additions, to be purchased out of the CSD revolving fund.

(v) Approving any additional finance for the revolving fund where computing is to be expanded.

(vi) Determining staffing levels of CSD operations.

28. Departments operating their own computers should follow cost responsibility principles by instituting costing systems and charging user sections for data processing. This will allow users to properly compare the alternatives of using either their own department's computer or CSD service.

Computing in the Health Services

Main Issues

8. Difficulties have been encountered in the control of this project and, while the events are now historical, this experience needs to be documented and lessons noted, so that such situations are avoided in the future.

9. The Department of Health Data Processing Division will not be in a position to give a commitment to any further significant implementation until the fundamental problems regarding the department's credibility with potential users, the data communications network, operation of the mainframes, and application efficiency are solved.

10. The embargo placed on development of computing systems prior to the commencement of the initial consultancy study has prevented justified growth of data processing in parts of the health services, particularly medical research.

11. A decision has to be made as to whether the continuation of the health services project can be economically justified and, if so, whether the managerial and technical problems can be overcome.

Recommendations

29. A decision should be made on whether a controlled attempt should be made to place the project on a sound footing. This would require:

(a) A change to the organisational structure to facilitate strong management decision making.
(b) The appointment of an experienced technical director together with the support staff necessary.
(c) A cost/benefit study.

If further significant implementation is not achieved within 12 months further commitment to the project should be reviewed.

30. Serious consideration should be given to setting up the present data processing division as a separate body under the control of a management board, representative of hospital boards and including either one or two members with technical expertise.
31. Full support should be given to the complete implementation of the project control methodology recently purchased by the State Services Commission. Senior Department of Health management, data processing division management, and hospital board management should be committed to meeting their obligations for project control.
32. The suitability of the existing mainframes to handle the task required should be determined by comparison with existing use elsewhere. If they are found to be suitable, adequate steps should be taken to tune them to handle batch tasks.
33. A single network software solution should be fully implemented. The necessary conversion of software should commence immediately.
34. The existing payroll application should be either redesigned or replaced.
35. The laboratory system should be abandoned unless some hospital boards accept the system in its current form.
36. Implementation of individual systems within boards should proceed only after the recommendations in pre-implementation reviews have been adopted.
37. Once the scope of the nation-wide systems has been re-defined, the Department of Health should encourage hospital boards to submit proposals for "stand-alone" systems, outside the scope of the nation-wide systems, where these can be shown to be the most cost-effective answer to their requirements. Where it considers such proposals to be appropriate, the department should support them and set standards for their development.

Control Over Large Computer Projects

Recommendations

38. Before any new large computer projects are undertaken a detailed project control methodology should be adopted as a standard. Such a methodology should provide for: top level management involvement; regular monitoring; highly skilled project manager; adequate and competent staff; operational level management review; sound design work; user commitment and support; proper use of sub-contractors.
39. Large computer projects should be authorised and monitored in discrete phases of time and cost. Approval to proceed to a succeeding phase should be dependent on the successful completion of the previous one. Large computer projects should

be subject to independent review at least once a year with the results reported to the appropriate approving authority.

40. Large computer projects should be required to recover set up and running costs over their life time. Every project should have a cost/benefit study completed before approval, and this then used as a yardstick during development. Staff should be required to report significant cost increases or delays in implementation dates to the approving body and to obtain a renewed approval before proceeding.

Computing in Educational Institutions

Main Issues

12. The Department of Education has a broad outline policy for the computing requirements of educational institutions other than universities. This outline has not yet progressed into a comprehensive policy for the full range of educational institutions encompassing administration, teaching, and research and has not been agreed by top officials and the Government. There is no clearly defined responsibility for teaching the various aspects of computer related studies.
13. There has not been formal co-ordination of software development to meet the common needs of educational institutions. Co-ordination is now being encouraged by the Department of Education for technical institutes and education boards.
14. Until 1980 there was little co-ordination of hardware purchases other than for the large university computers in the early 1970s. This has hindered shared software development and possible mutual communication links.
15. There are some university tasks which require large computers or access to specialised software. It is unlikely that very large computers or specialised software could be individually justified at each university.

Recommendations

41. The Department of Education should form a broadly-based advisory committee for EDP, drawing members from the public sector, including educational institutions, and the private sector. The committee should help formulate policy proposals for both the provision of computing resources and the allocation of responsibility for teaching different computer related courses.

42. The Department of Education's broad outline policy for computing should be developed into a more comprehensive policy for the computing resources of technical institutes, community colleges, teachers training colleges, education boards, and secondary schools. This should encompass both administrative and teaching requirements. The policy should be reflected in a rolling 5-year plan for hardware purchases which should be agreed by both top officials and ministers.

43. The comprehensive policy, covering computing resources for university administrative, research, and teaching requirements, developed by the University Grants Committee, should be

integrated with the Department of Education policy to ensure consistency. University computing policy should also be reflected in a rolling 5-year plan for hardware purchases, outside the quinquennium, which should be agreed by both top officials and ministers.

44. A co-ordinated syllabus for all levels of computer related studies for technical institutes and secondary schools should be developed immediately through the Department of Education in consultation with interested user bodies.

45. Within each group of educational institutions, the advantages of shared software development should be realised. This will require compatible hardware at each institution but will allow each organisation to retain operational control and develop some software for specialised requirements.

46. The Department of Education advisory committee on EDP, already recommended, should co-ordinate computer hardware procurement for education to limit the variety of machines and allow economies of bulk purchasing. This would assist software development, maintenance, and the transfer of staff and students.

47. Each university should co-ordinate all computer hardware procurement through a computer committee and between universities through the University Grants Committee and the Vice-Chancellors' committees system.

48. University research computing should have access to the spare, off-peak overnight capacity of the large central government centres, with safeguards for data security. This could be especially suitable for batch research tasks.

49. Where high cost specialist software is required, consideration should be given to university use of software at central government centres. Where such collaboration already exists, consideration should be given to expansion of the service. Alternatively, it could be purchased by a single university but used also by staff and students from others.

Computing in Local Government

Main Issues

16. Few top managers in local government have the necessary training and experience of computers to fully plan and control data processing resources.
17. There has been extensive duplication of applications development effort by individual local authorities.
18. The approach to applications development varies widely. In half the installations visited users were not sufficiently involved at critical stages of development.
19. The effect of loss of data processing staff is of greater significance to local authorities than to the rest of the public sector. The smaller numbers employed within organisations means greater dependence on individuals.
20. The lack of technical expertise in some local authorities has meant that procurement decisions have been made without sufficient regard to all relevant criteria.

21. Application development has been concentrated in the basic accounting area rather than also servicing the potentially more effective areas of planning and optimisation.

Recommendations

50. Top management in local government should receive sufficient training in data processing to enable them to take an active role in the planning and control of data processing resources. The Local Government Training Board should be encouraged to make provision for suitable training in data processing as part of management training courses.

51. Elected members should ensure that they are adequately advised on the data processing consequences of their decisions.

52. Local authority associations should take an active role in promoting the sharing of existing software and the co-ordination of future developments.

53. Local authority data processing installations should adopt formal standards for applications development, relative to the size of installation. These standards should lay down acceptable levels of user involvement and documentation. Responsibility for the development of standards suitable for local authorities should be with the advisory group suggested in Recommendation 55.

54. Local authorities should recognise the risk of reliance on a small number of data processing staff. Steps should be taken to spread knowledge and expertise among a wider range of staff to ensure continuity. Documentation should be adequate to allow continued operation and ease of applications maintenance in the event of loss of key personnel.

55. A specialised consultancy group should be established to provide local authorities with technical advice on computer systems and equipment. The appropriate local authority associations should promulgate the establishment of such a group.

56. Data processing sections should be recognised as a service function to the whole organisation. The EDP function should be organisationally separated from operating sections and report to the member of top management responsible for management services.

57. Recognition should be given to the potential of the full range of applications to improve effectiveness of the whole organisation.

58. Access to specialised central government software should be expanded to a wider range of local authorities.

APPENDIX 8

GLOSSARY

Acquisition	The entire process of identifying the need for computer systems, specifying requirements, assessing appropriateness of particular systems, purchasing or other methods of obtaining computer systems, and making the system operative.
Application	Program or series of programs which together form a system for a particular area of work, e.g., payroll.
Back-up	Equipment or procedures available for use in the event of failure or overloading of equipment or procedures.
Block size	The number of records incorporated into a single block, a block being a set of data transferred as a unit between components of a computer system, e.g., from a disc to main memory.
Buffer	Temporary or intermediate storage used to hold data being transmitted between input or output devices and internal storage.
Business analyst	Person with the understanding of user needs able to prepare a statement of user requirements for a computer system.
Catalogue	Generally used in connection with program and file libraries to enable specific information or programs to be located readily.
Channel	A path or group of paths for transmitting input data to, or output data from, a computer to a peripheral device.
Channel controller	The equipment which controls the flow of data, e.g., to several different peripherals.
Communications protocol	The formalised procedures by which computers are able to communicate with other computers or with terminals.
Compatibility	The ability to handle programs and data from one computer system on another computer system without modification.
Computer operator	Person who sets up the necessary equipment and software to run computer jobs.
Conversion	Process of changing computer programs and or files from one computer system to another or the process of changing from one data processing method to another.

Cost/benefit analysis	Method of establishing a comparison of costs and benefits between a number of options for undertaking a pre-determined activity.
CPU	Central processing unit, the main processing component of a computer system. It includes the circuits which control the interpretation and execution of program instructions as distinct from the peripheral components.
Data base	An organised set of files providing a common pool of information for several or many users.
Data communications	The sending and receiving of data over a telecommunications system.
Data control	The physical control of data.
Data preparation	The preparation of data into a suitable format for input to the computer; or the actual entry of data into a computer.
Data logger	Device which records details of data from some physical activity (e.g., river flow levels) often in a form able to be read by a computer.
Disc	A type of magnetic storage device.
Disc seek	The method by which data stored on a disc is located. 'Seek time' is the time required to locate the data.
Distributed processing	A system that assigns tasks within an organisation to smaller computers or intelligent terminals on the basis of location or type of task.
EDP	Electronic data processing.
Hardware	The machinery constituting a computer including peripheral devices.
Hardware monitor	Equipment used to measure hardware activity.
Head movement	Movement of the read-write head on a disc file during a seek operation.
Input	Information transferred into the internal storage of a data processing system.
Input/Output	General terms for the techniques, devices, and media used to communicate with data processing equipment, and for the data involved in these communications.
Interactive systems	Systems which enable direct interaction between the user and particular applications.

Mainframe	Same as CPU.
Memory	That part of a computer that stores the program, holds intermediate results, and various constant data.
Micro-computer	A very small computer based on microprocessors.
Microfiche	A form of microfilm frequently used in data processing as an alternative to printout.
Mini-computer	A small computer which has many of the same characteristics as large computers.
Modem	A device which electronically transforms signals from the mainframe and terminals into a form suitable for transmission over telephone lines.
Network	The interconnection of a number of computers and terminals by data communication facilities.
New policy	All proposals made by Government departments for additional funds which introduce a new activity or significantly alter the size, scale, scope, or quality of an existing activity.
Node	Small computer for switching data in the data communications network.
Noise	Any disturbance which interferes with the normal operation of data communication systems.
On-line	Equipment or devices which are in direct communication with the central processor of a computer system.
Operating system	A computer program which organises the whole interrelationship between computer, peripherals, input/output, and applications.
Output	Information transferred from the internal storage of a data processing system to any device external to the system.
Package	Standardised software or predeveloped computer applications, usually those commercially available.
Packet switching	Concept of data communications where the transfer of data is handled by an independent organisation to make more efficient use of the telephone system. Data from several sources is accumulatd and then forwarded in larger "packages" to another part of the packet switching network.

Peripherals	Units that are attached to and work in conjunction with the computer but are not part of the computer itself, e.g., discs, printers.
Planner/ analyst	Person with business analyst and systems analyst skills.
Plug compatible	Equipment which is directly interchangeable with other manufacturers' peripherals, processors, or memory.
Procurement	That part of the acquisition process concerned with specifying the requirement to suppliers, selecting a supplier, and purchasing (or leasing) the computer equipment or software.
Program	The complete sequence of instructions and routines necessary for a computer to carry out a given task.
Programmer	Person who writes computer programs.
Project control meth- odology	A commercially developed and marketed set of standards and procedures for the development of applications.
Sizing	Estimating the hardware resources required to operate a particular system.
Software	The general term for computer programs including compilers and operating systems, and applications programs.
Software monitor	Computer programs used to measure the activity within computer equipment.
Systems analyst	Person able to define user requirements and design a computer system ready to be programmed.
Systems pro- grammer	Person responsible for interrelationship between systems software, applications software, and hardware.
Systems software	Programs, other than applications programs, including compilers, data base management systems, data communications protocols, and operating systems.
Terminal	An input/output device in a data communications network at which data can enter or exit, e.g., a visual display unit.
Tuning	The discovery of bottlenecks in the total system through monitoring the operation of individual components and how the hardware interacts with the operating system.
Turn-key	Situation in which a vendor supplies the complete hardware and software as fully developed systems.

BY AUTHORITY:
P. D. HASSELBERG, GOVERNMENT PRINTER, WELLINGTON, NEW ZEALAND—1980
50221—80PT